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(Chief Surgeon: WERNER MÖLLER, M. D.)

## Solitary Neurinoma of the Small Intestine.

By

WERNER MÖLLER.

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Since, some decades ago, VEROCAY delimited the neurinoma as a histologically separate and independent form of tumour, it has attracted great interest, especially as regards its formal genesis and its delimitation from other tumours with much the same morphological properties, but it has also attracted appreciable attention from clinical points of view, as is evidenced by the numerous casuistic reports.

The neurinoma exhibits a characteristic microscopical picture; it is built up of spool-shaped cells, often in syncytial aggregations, with whirlshaped, often palissade-like arrangement of the nuclei; with van Gieson staining the cell elements show a yellowish or yellowish-brown colour.

No unanimity has been reached with regard to the formal genesis of neurinomas; the majority of authors consider that they originate from the ectodermal cells in the sheaths of Schwann (VEROCAY, ANTONI, SOMMER, DENECKE, LHERMITTE and LEROUX, etc.) or their embryonal preliminary stages, the lemmoblasts (FRETHEIM, ERB, etc.), which conceptions are reflected in the names given to this form of tumour: Schwannoma, Schwannoblastoma, lemmoblastoma. Other authors trace them from the sheath of Henle (endoneurium), *i. e.* from a mesodermic origin (MALLORY and others).

On the whole, neurinomas may appear anywhere where there are nerve fibres (peripheral, sympathetic and parasympathetic); the places of predilection are the pons angle (the so-called acoustic nerve tumours) and the spinal medullary canal, especially the posterior roots (ANTONI), but neurinomas have been found in the



most varied regions and organs. Thus they have been observed in the pharynx, tongue (HARBITZ, FROBOESE), the lip (ERB), supraclavicular fossa, intercostal space (ERB), retroperitoneum (FRETHEIM), the skin, and internal organs, such as the bronchi, the urinary bladder (STEDEN), etc., and in different sections of the alimentary canal. Within the latter they may appear in different forms, sometimes as a part phenomenon of and combined with a multiple, cutaneous neurofibromatosis (RECKLINGHAUSEN), and sometimes, but exceptionally, as multiple small tumours, most frequently unimportant clinically, and finally, as solitary formations which form appears to be the most usual, and the only one which is of any practical clinical interest.

The most usual localization within the alimentary canal is the ventricle, where a couple of hundred cases have been demonstrated and described (LAGERGREN—SJÖVALL). It appears not improbable, however, that this form of tumour is more general than the published cases indicate, for, according to GOSSET, BERTRAND and LOEWY, a large number of "les tumeurs pédiculées gastriques", which were earlier interpreted as malignant leiomyomas, sarcomas of various kinds, etc., should be assigned to the neurinoma group (Schwannoma), which might be explained by the circumstance that the interpretation of the histological picture varies so greatly.

It is certainly possible that this also affords the explanation of the strikingly small number of published cases of solitary neurinomas in the intestine; but it appears from certain collocations that this localization actually seems to be very rare. Thus RAI-FORD (1932) found no neurogenic tumour among 88 tumours of the small intestine in the Johns Hopkins Hospital material; nor in their material of benignant tumours of the small intestine, a total of about 50 cases, could RANKIN and NERVELL, GOLDBERG, COHN, LANDY and RICHTER establish any of neurogenic origin.

It will probably be justifiable to exclude from the group of intestinal neurinomas proper the so-called appendix neurinoma, which has rather the character of a neurinomatosis, without delimited tumour formation. According to MASSON and OBERNDORFER they could almost regularly be proved in cases of obliterating appendicitis, and according to SCHWEITZER, in 60 % of all chronically changed appendixes.

Only about 20 cases of solitary neurinoma of the intestine have been published hitherto. In 1937 BERGENDAHL and SJÖVALL

collocated a total of 10 cases from the literature, in addition to one case of their own, and recently, in connection with his own observation, HEDLUND found a further 7 published cases. There are probably further cases, which, owing to the difficulty, in the abnormal conditions of recent years, in the way of obtaining medical literature, it has not been possible to track down.

The paucity of known cases of solitary intestinal neurinomas appears to me to justify the publication of a further case which I have treated.

### Case Report.

*F. N. Man, aged 42.* Previously healthy, without digestive disturbances. For one month abdominal troubles in the form of flatulence and colic pains. Motions normal; has not observed any blood or mucus. No urination troubles. Has not lost weight. On  $13/2$  1943 increased trouble. Sent in by his doctor for tumour abdominis (cyst?).

Admitted to the Surgical Department on  $22/2$  1943. Good general condition; ordinary physique. Temp. 37.4. Lungs and heart normal. Sedimentation rate 8 mm. Heller and Almén neg. Weber neg. Abdomen everywhere soft and insensitive, nothing abnormal palpable. Per rectum: normal prostate, for the rest nothing pathological. Discharged on  $24/2$  free of trouble; no criteria for any surgical affection; no abdominal tumour palpable.

Since then has felt well and has been working as usual, but he thinks that recently his abdomen has been increasing in size. Still no evacuation or urination troubles.

Again admitted to the Surgical Department on  $10/4$  1943. Abdomen soft everywhere; in the lower part, extending over to the right fossa iliaca, is palpated a cystic tumour fully the size of a child's head, with a fairly soft, elastic, somewhat tender outward bulge, fully the size of a hen's egg, above the right groin. Per rectum the tumour is palpated to extend down into the small pelvis.

$13/4$  X-ray examination of the colon with contrast which passes in easily; the tumour compresses the colon sigmoideum but does not appear to engage the colon for the rest; within other parts of the colon no changes provable.

*Epicrisis.* This is a case of a cystic tumour, the nature of which is difficult to determine. Its relative mobility definitely indicates that at least the greater part of it is intraperitoneal. It is probably not a question of an omental cyst, as the tumour would be still more mobile. Its position and clear delimitation upwards argue against a dystopic hydronephrosis. It is most probably a matter of a mesenterial cyst or an enterocystoma. Indication for an operation clear.

$13/4$  Operation. *Extirpatio tumoris + appendectomy* (spinal anaesthesia). No ascites. The tumour larger than a man's head; it reaches to the plane of the navel and extends down into the small pelvis, which is quite

filled by it, and here it is adherent to the peritoneum anteriorly towards the bladder and to the flexura sigmoidea. For the most part the adhesions could be loosened without cutting with moderate hemorrhage. At the top the tumour is free, except in one place, where it is intimately attached to a coil of small intestine, the wall layer of which passes into the tumour. About half the circumference of the intestine is excised, and the tumour removed. The detached peritoneum in the small pelvis is sutured, so that the pelvis is well peritonized. Abdominal suture.

The after-course was completely free of complications; the intestinal passage normal the whole time; no vomiting. Healed per primam. Discharged 27/4.

<sup>2</sup>/<sub>11</sub> 1946. *Communication from the patient*: Feels well, has not been ill since the operation; works every day as before. No abdominal trouble, digests his food well, daily evacuation. Weight as before the operation.

*Preparation*. The tumour is a somewhat irregularly shaped cyst, larger than a man's head, c. 15 × 20 cm. It consists of a large cyst cavity and, communicating with it through an opening the size of a hen's egg, a cyst the size of an orange with a furrow on the surface as from a tightened string. In one place in this depression is attached broadly a part of the excised intestinal wall (see fig. 1) of the size of a 2-shilling piece, which appears to pass into or form a part of the wall of the cyst. No provable communication between the lumen of the cyst and that of the intestine. The whole inside of the cyst is covered with adherent coagula.

The greater part of the wall of the cyst (see fig. 2) is thin, in certain places as thin as paper; on a segment nearly the size of the open hand the wall is thicker, up to 1—1 ½ cm., and in that place an outer, homogeneous, greyish, medullary zone about 5 mm. in breadth can be distinguished, and inside that an approximately equally broad, reddish-brown zone, which appears to consist of tissue drenched in blood, and furthest in adherent old coagula and a number of spaces up to the size of cherries, full of semi-solid masses. For a length of 5—6 cm. the wall is fully 2 cm. thick, firm, and in section the tissue is white, medullary, with red streaks and spots.

*Microscopic examination* (Prof. O. REUTERVALL). Fig. 3 and 4.

»Sections from the wall of the cystic tumour exhibit a tissue abundant in cells, and built up of small to medium-sized, on the whole spool-shaped, cells, elongated in places. Clusters of cells in whorl arrangement. In some places fairly well marked palissade arrangement of the nuclei, which are rod-shaped, rounded or slightly irregular in shape, as a rule moderately abundant in chromatin, in places hyperchromatic. An occasional mitosis. The cell cytoplasm sometimes scanty, sometimes fairly abundant, in the van Gieson stained sections pale-yellowish; in places thread-like, yellowish structures. The cell borders not sharply defined. In several places clear syncytial arrangement of the cells. Between the clusters of cells, connective tissue, in narrow or fairly wide streaks in several places. The tumour tissue is delimited outwards by a capsule-like layer of connective tissue. Towards the lumen in several places in the tumour tissue, which is here abundant in vessels,



Fig 1. Photograph of the tumour.

Observe the part of the small intestine adherent to the tumour.

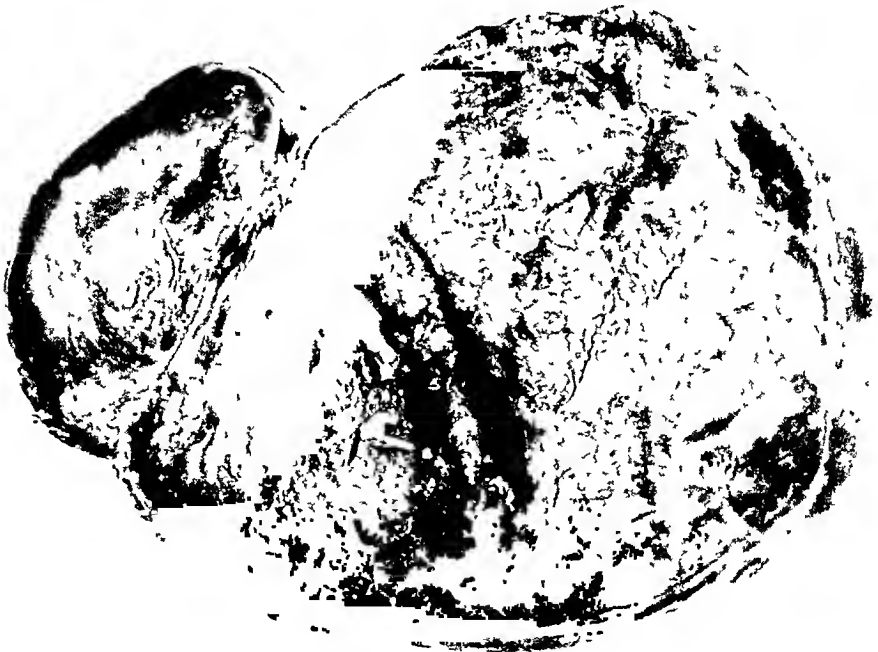


Fig. 2. Section through the cyst.

MOLLER: Solitary Neurinoma.

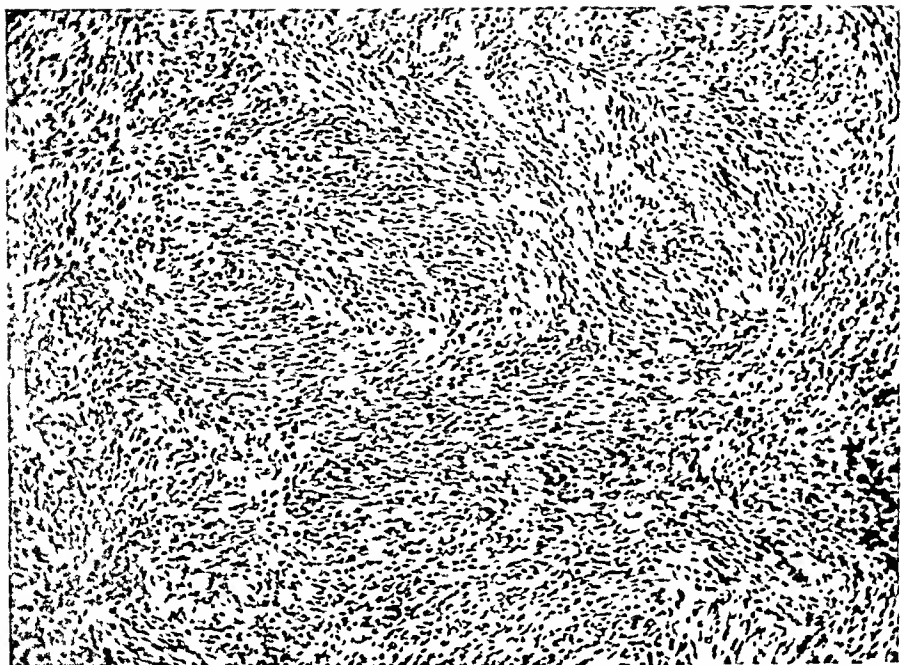


Fig. 3. Photomicrograph of a section through the tumour. ( $\times 50$ .)

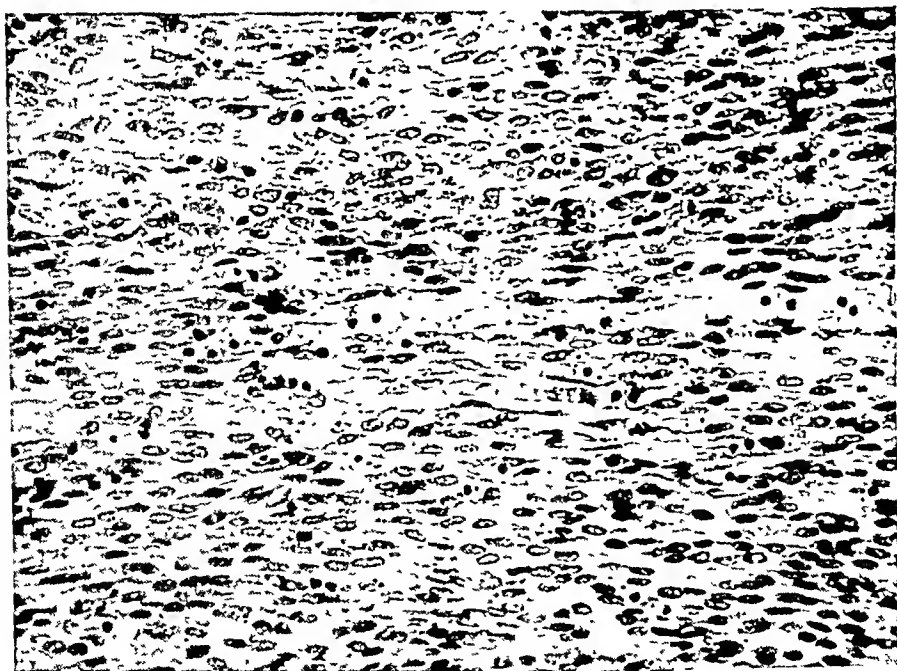


Fig. 4. High-power magnification, showing the type of cell. ( $\times 250$ .)

are observed hemorrhages, oedematous areas with ruptures of the cells, necrobiosis to necrosis. Aggregations of hemosiderin macrophages. In some places nearest to the lumen hyalin fibrous tissue, in places in lamellae parallel to the lumen.

This is a neurinoma or neurolemmoma with diffuse secondary cystic disintegration. The abundance of cells is certainly great, but nothing definite to indicate sarcomatous degeneration has been found.»

In the great majority of cases the solitary neurinoma has been localized in the small intestine, in only 2 cases in the cecum (MANTZ, BAUMEISTER), in 1 in the duodenum (DENECKE), and in 1 in the rectum (KREKELER). Their matrix in the intestinal wall is the nervous plexus myentericus and submucosus, from which, as well defined expansively growing tumours — usually at the mesenteric attachment (KÖNIG, MONCHET and SAMAIN, BONNIOT, etc.), more rarely from the part of the intestinal wall opposite to the mesentery (BORRAS and BENITO, ARNVIG, *the present author*) — they develop in different directions, intramurally (LHERMITTE and LEROUX), in towards the intestinal lumen as submucous, even polypous formations (LEMONNIER and PEYCELON, SJÖVALL, SCHOUSBOE), or most frequently out towards the serosa, here also to pass into broad-based or more or less pedunculated tumours (DENECKE, BAUMEISTER, BONNIOT, *the present author*). The size varies from that of an almond to that of more than a man's head. On the surface they are often irregular and nodose, and the section surface exhibits, in the more solid forms, an uneven, macular, speckled, marbled appearance, with more or less numerous and diffuse hemorrhagic streaks and areas, sometimes necrotic areas; more rarely the section surface is homogeneously firm. At times the tumour tissue is spongy, fragile, disintegrating, and the occurrence of larger or smaller hollow spaces, spread over the section surface or situated centrally is very usual. In occasional cases the disintegration inside the tumour is such that the greater part of it is transformed into cystic formations (BORRAS and BENITO, BONNIOT, *the present author*). In a couple of cases these hollow spaces (BERGENDAHL and SJÖVALL, MONCHET and SAMAIN) communicate with the intestinal lumen, in one case (BERGENDAHL and SJÖVALL) also with the serosa.

The *symptomatology* of intestinal neurinoma varies, and often it is hardly distinguishable from that of other abdominal tumours. In the individual case, however, the morbid picture is dominated by a certain complex of symptoms which is conditioned by the

anatomical state of the tumour. It is relatively usual for the patient to exhibit the picture of an «acute abdominal case» with pain, possibly accompanied by other symptoms met with in that morbid picture, nausea, vomiting, fever, etc. In some of these cases peritonitis symptoms predominate, and they find a natural explanation where, as in BERGENDAHL—SJÖVALL's case, there is a communication, on the one hand, between the lumen of the intestine and the disintegrating cavity, and on the other, between the latter and a rupture of the serous covering of the tumour. In KÖNIG's case with purulent peritonitis, where there was no such communication, it will probably have appeared by way of the lymphatic ducts from the central disintegration.

The conditions for the appearance of the mechanical ileus state may seem to be favourable; a submucous development of the tumour might cause obturation or invagination, external pressure from tumours, which sometimes are large, may compromise the intestinal passage, and a possibly pedunculated, subserous tumour may give rise to torsion of the latter or to volvulus of the intestine. Such symptom pictures are seldom met with, however; NORDLANDER's and SCHOUSBOE's cases certainly exhibited evident signs of ileus, even at the operation, but no more alarming such signs have been found. In the cases where abdominal pains were the chief symptom appendicitis was diagnosed or, if a palpable tumour was also found previously, usually a gynecological affection, such as twisted ovarian cysta (BORRAS and BENITO, MONCHET and SAMAIN), or extra-uterine pregnancy (BAUMEISTER).

The above-mentioned communication between the tumour cavity and the intestinal lumen has often been held responsible for the intestinal hemorrhages which have sometimes appeared in cases of intestinal neurinoma and have been the most pronounced symptom; in certain cases they have also been the immediate, though misinterpreted, indication for operation (LEMONIER and PEYCELON, ARNVIG, HEDLUND). In a couple of cases such hemorrhages had occurred previously (KÖNIG, NORDLANDER). However, it proves that, as far as is known, no hemorrhages occurred in the few cases where such a communication actually could be proved (BERGENDAHL and SJÖVALL, MONCHET and SAMAIN), and that in a couple of the hemorrhagic cases (ARNVIG, HEDLUND) the mucous membrane covering the tumour did not exhibit any macroscopical ulceration, as in LEMONNIER and PEYCELON's case. The cause of the hemorrhages is therefore certainly the

same as in the case of other intestinal tumours, stasis, ulceration, etc.

A usual symptom was a tumour palpable either in the abdomen or per rectum-vaginam. It is explicable that such a tumour could not be proved in cases where it was small or where an existing peritoneal irritation made the diagnosis more difficult. It is more remarkable that tumours of some size (the size of a fist or larger) can escape detection (HEDLUND, *the present author*, 6 weeks before the operation), and this may probably be explained by their greater mobility and not only by inadequate examination.

As can be seen, in cases of intestinal neurinomas there is no even approximately characteristic symptom which can guide the epicritic discussion in the right direction. Therefore, in the majority of cases, the clinical diagnosis has been purely symptomatic: peritonitis, ileus or intestinal hemorrhage, in other cases it has not gone further than abdominal tumour; in the case of women most frequently ovarian tumour or something of the kind, sometimes mesenteric cyst or enterocystoma (the present author). A more precise diagnosis: "suspected, bleeding, benignant tumour of the small intestine" was made, however, in the case published by HEDLUND.

Even though intestinal neurinomas can only exceptionally be diagnosed as such, their general symptomatology — according to present experience — will probably be so evident or even obtrusive, that the risk of neglecting rational treatment, *i. e.* laparotomy, is practically non-existent. On the other hand, there is a question of detail of great practical importance, which is not equally simple and clear, namely whether these tumours are benignant or malignant, a question which is naturally decisive for the prognosis and for the choice of the method of operation, and which will therefore be touched upon.

The prevalent opinion on this question seems to be that neurinomas are extremely benignant tumours (SCHRAGER, BORCHARDT, GULEKE, LECÈNE, etc.), nay, some of these authors consider that no malignant neurinomas have been proved (SOMMER, ERB, etc.). On the whole, this opinion as regards ventricle neurinomas is shared by LAGERGREN and SJÖVALL, who say that "both clinically and histo-pathologically they are clearly benignant", they point out that mention of malignant degeneration is very rare, and that relapses after operated ventricle neurinomas are probably "extremely rare", which they consider is confirmed by the fact



that in none of their 11 cases had relapses occurred within 1—5 years after operation.

Microscopic decision as to malignancy appears to be difficult; in general the tumours are very abundant in cells, and it seems that mitoses, polymorphism, hyperchromasia and other cell changes, may be met with, even in tumours which, from the clinical course, must be considered benignant. The histological picture of the primary tumour has been stated to be benignant in the cases of intestinal neurinomas published by DENECKE, LEMONNIER and PEYCELON, BORRAS and BENITO, BERGENDAHL and SJÖVALL, ARNVIG, SCHOUSBOE, HEDLUND, SJÖVALL, *the present author*. Even though undoubted signs of malignancy have not been described in any case reported, a number of authors show a certain reserve on this point. Thus in his case NORDLANDER adds to the diagnosis of neurinoma the word "sarcomatodes?" on account of a pronounced polymorphism and cell atypia, and BAUMEISTER considers that his case is not entirely free from suspicions of sarcomatous degeneration. BONNIOT's apprehensions of a risk of a relapse owing to mitoses were justified by a relapse appearing 1½ years later; this showed a microscopic nature akin to the primary tumour, but in several places there were also cells with giant nuclei and mitoses, showing that it was a tumour "in full activity", without its being histologically possible to confirm its malignancy. Owing to its abundance of mitoses, SJÖVALL also apprehends one of his tumours "as probably malignant".

The difficulty of judging the biological properties of a neurinoma from the morphological picture, which appears from the examples adduced, is further increased by the experience that a microscopically benignant primary tumour may prove to be malignant by giving rise to metastases or relapses. One such case of histologically benignant duodenal neurinoma and, *inter alia*, liver metastasis of the size of a fist, with a considerable abundance of cells and in places extreme cell atypia and giant nuclei, has been described from Aschoff's Institute by DENECKE. In BERGENDAHL-SJÖVALL's case, where intestinal resection was performed for a microscopically benignant neurinoma, a relapse took place after 3½ years of good health, with extensive peritoneal metastases whose histological structure diverged from that of the primary tumour only in an abundance of mitoses.

These experiences of the strong suspicions indicated in certain

cases of morphological malignancy in the primary tumour, and that neurinomas interpreted microscopically as benignant have revealed their malignant character in metastases or relapses, seem to me decidedly to gainsay the prevalent opinion that neurinomas are "extremely benignant" tumours. The result of this, in respect of our choice of operation method, should naturally be that we ought not, as some authors suggest, to limit the operation to a simple extirpation of the tumours, but to treat them as at least potentially malignant, *e. g.* analogously with the principles for the treatment of other malignant intestinal tumours, to make sufficiently large resections of the intestine and mesentery, irrespective of whether their relation to the wall of the intestine, mesentery or adjacent organs render them necessary. In the case I have described the tumour was certainly apprehended as benignant, and a conservative operation performed, owing to my ignorance at the time of the properties of these tumours. Even though, judging by the favourable course hitherto (*c.* 3 1/2 years without relapse) the operation appears to have been satisfactory, this should be looked upon as a fortunate chance and not be taken as a justification for conservative operation as the normal method. Owing to the great difficulty at the operation of distinguishing neurinomas from other apparently benignant intestinal tumours, it also seems advisable in every case, possibly with the exception of subserous, fine-stalked tumours, to recommend intestinal resection as the normal method. Judging from present experiences no increased risk worth mentioning need be apprehended.

In general, in the cases published, intestinal resection was performed, simple extirpation only in some cases (KÖNIG, BAUMEISTER, BORRAS and BENITO, *the present author*). Whether this was dictated by fear of malignancy or by purely technical reasons, however, it is impossible to judge, partly owing to the meagre descriptions, and partly to the fact that authors have seldom discussed this question. Even though in their case MONCHET and SAMAIN were compelled to perform intestinal resection in view of the relation of the tumour to the mesentery, they point out that the treatment should consist of simple extirpation, owing to the benignant nature of the neurinoma. On the other hand, BERGENDAHL and SJÖVALL advise resection when the possibility of malignancy cannot be excluded.

The immediate results of the operations have been good, unless

the circumstances have been specially unfavourable; the fatal issue in some cases has been due to hemorrhagic shock, pneumonia, liver metastasis or (in a 73-year-old patient) ileus which was already present before the operation.

A judgment of the malignancy of intestinal neurinomas on the basis of post-examinations in the cases operated on is very hazardous, as information on the subject is sparse and the observation period all too short. Mention has already been made of the cases of BONNIOT and BERGENDAHL and SJÖVALL, in which relapses took place after 1½ and 3 years respectively. For the rest information about the subsequent condition is only given in 4 cases (BAUMEISTER, MONCHET and SAMAIN, SCHOUSBOE, HEDLUND), where the patients were free of symptoms for from some months up to 1 year and 4 months; and in my case the patient was completely restored to health and working capacity c. 3½ years after the operation.

### Summary.

After a short survey of the general histology, formal genesis and localization of neurinomas and a brief review of the occurrence of neurinomas in the alimentary canal, and of the hitherto published cases in the intestines, the author describes a case of a 40-year-old man with a neurinoma of the size of a man's head in the small intestine; it was extirpated. The tumour consisted of one larger and one smaller cyst, the walls of which were thin for the most part. Microscopically the neurinoma showed no criteria for malignancy. Healthy and free of relapse after 3½ years. The localization, anatomical properties, and symptomatology of intestinal neurinomas are discussed. Special attention is paid to the question whether neurinomas should be considered malignant or benignant tumours; a scrutiny of the published cases, from both the morphological and clinical points of view, appears to justify the conclusion that, from the practical surgical point of view, they should always be apprehended as potentially malignant, and the choice of operation method should be made with this in mind. In principle the method should be intestinal resection and not simple extirpation.

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Copenhagen.

(Chief: Professor E. HUSFELDT, M. D.)

## Intrathoracic Gastric Cyst.

By

J. C. CHRISTOFFERSEN.

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Only few cases having been reported in the literature of gastrogenic intrathoracic cysts we have considered ourselves justified in reporting the following case which was recently treated in the thoraco-surgical department of the Rigshospital.

The case was that of a 22 months old boy. Admitted 15 Sept. 1946, discharged 3 Oct. 1946. (Case No. 204/46). The patient is an only child. His development has been normal, never ill, in particular no symptoms on the part of the respiratory organs. Owing to tuberculous contacts the child was examined at the tuberculosis clinic about one month prior to admission here. Roentgenographic examination of the thorax demonstrated a sharply defined shadow,  $8.5 \times 6$  cm. on the right side, posteriorly and downwards. After observation over a month during which period there were no changes in the roentgenographic finding, nor in the condition of the child, the patient is admitted to this department for a pulmonic cyst on September 15th, 1946.

*The objective examination* showed a well-developed boy of good general appearance. No dyspnea or cyanosis. No difficulties in swallowing. Lung stethoscopy: Nothing definitely abnormal. The routine objective examination or usual laboratory examinations showed otherwise nothing abnormal. — *X-ray* (Fig. 1) of the thorax shows in the lower portion on the right side a quite sharply defined oval shadow-formation slightly larger than a goose egg, one pole pointing towards the 11th dorsal vertebra. On a lateral view it is seen to be situated quite posteriorly in the thorax, forming a clear impression on the posterior part of the right diaphragm. It does not move with the respiration as would a pulmonary cyst. The surrounding structures are completely normal. We are most inclined to believe that we are concerned with a neurinoma, and Sept. 19th right-sided *thoracotomy* with resection of the eighth rib is performed in intratracheal  $N_2O-O_2$ -ether anesthesia with ventilator. The lung free. A cystic tumor almost the size of a Jaffa orange is revealed, arising from the mediastinum immediately above the dia-



Fig 1.

CHRISTOFFERSEN: Intrathoracic Gastric Cyst.





Fig. 2.

phragm. The pleura mediastinalis is divided posteriorly, and the tumor is dissected free partly with the knife, partly bluntly, being separated from the azygos vein, the vagus nerve and the esophagus. Eventually it is only attached to the pleura mediastinalis anteriorly and is removed after division of this. While the cyst is being freed a quantity of clear mucous contents is evacuated from a tear in it. A small rupture of the left pleura is closed and after hemostasia the pleura mediastinalis is sutured, a small opening being left, however, as a drain. After inflation of the lung the thoracic wall is closed without drainage in the usual manner. The operation takes barely an hour. The patient is awake towards the end of the operation. Roentgenographic examination shows both lungs to be practically fully expanded.

The postoperative course was uneventful. No exudate developed. The sutures were removed Sept. 27th, and the child was discharged Oct. 3rd in comfort and ease.

Macroscopic examination of the tissue removed showed this to be a unilocular, smooth-walled cyst. The *histologic examination* (Fig. 2) demonstrated the wall of the cyst to have a thick layer of smooth muscle which presents a clear stratification the two layers coursing at right angles to each other. Luminally a narrow zone of connective tissue is seen lined with a mucous coat closely resembling the gastric mucosa. The surface is uniformly rugated, covered by a tall, light, cylindrical epithelium and below this layer there is a zone of uniform small spheroidal glands, in which it is often possible to differentiate two kinds of epithelium, one of which resembles parietal cells. Nowhere respiratory



epithelium, squamous epithelium, sebaceous glands or hair is to be seen (signed: W. KLÆR).

There can be no doubt that the cyst removed should be included in the group: gastrogenic mediastinal cysts.

As a consequence of the many different elements of tissue present in the mediastinum, tumors may occur of practically any description, and the literature has instances to show of practically any conceivable form of mediastinal tumor. The great majority of the cystic tumors are congenital. By far the greater majority of them belong to the groups of dermoid and teratoid cysts, more than 250 of which are described in the literature. Among the cystic tumors of less frequent occurrence are the bronchogenic cysts, the pericardial celomic cysts, thymus cysts, cystic lymphangioma and, finally, the group of cysts which have the feature in common that they are made up of the same layers as those found in parts of the digestive tract: the esophageal, gastrogenic and enterogenous mediastinal cysts. Etiologically these cysts must be considered to be derived from pinched off anlagen from the embryonal digestive tract. The presence of gastric and intestinal mucosa in the thorax is explained in the way that these anlagen were pinched off at a very early stage of development — before the formation of the diaphragm — and they are generally considered to be pinched-off diverticula of the foregut, even before differentiation took place of the ectoderm in the esophageal, the gastric and the intestinal mucosa, or from intrathoracic remnants of the omphalo-mesenteric duct. Some few authors mention the possibility that it may be a question of dislocation of the islands of the gastric mucosa so often present in the esophagus.

Up to now 17 cases of gastrogenic mediastinal cysts are reported in the literature: STAEBLIN & BURCKHARDT 1909, MIXTER & CLIFFORD 1929 (2 cases), SMITH 1930, FISCHER 1930, ENTZ & OROSZ 1930, PONCHER & MILES 1933, BÖSS 1937, SEYDL 1938, NICHOLLS 1940, SCHWARTZ & WILLIAMS 1942 (2 cases), CARLSON 1942, WYLLIE & PILCHER 1943, OLKEN 1944, LAIPPLY 1945 and VALLE & WHITE 1946. To these cases must be added our case as No. 18. Of these 18 cases, 7 were found by autopsy, two of them in newborns, the others in surgically treated cases, all the patients being children below 4 years of age (average age: 16 months).

One of the reasons why the gastrogenic cysts give symptoms so early is that a greater number of them are active, that is to

say, acid-secreting. This holds good of at least 9 of the cases reported up to now; in 2 cases (Böss 1937 and Seydl 1938) there was even a perforation of a peptic ulcer in the cyst, terminating fatally in both cases. Also in the case reported by VALLE & WHITE a peptic ulcer is presumed to be present owing to the fact that the cyst perforated to the bronchus and gave rise to hemoptyses. In the inactive cysts the symptoms hardly differ from those met with in other mediastinal tumors: dyspnea, cyanosis, cough, pain and, occasionally, difficulty of deglutition. In our case the cyst had till it was incidentally discovered by a roentgenographic examination, given no symptoms. This coupled with the fact that the contents of the cyst which was evacuated intrapleurally during the operation did not cause any form of irritation or exudation, makes it likely that this cyst should be included among the inactive cysts.

The differential diagnosis can hardly be supposed to be of great interest as the occurrence of a mediastinal tumor which is identifiable by roentgen examination will as a rule afford sufficient indication for thoracotomy. It should be mentioned, however, that the gastric cysts are always located in the posterior mediastinum — unlike the dermoid cysts which most frequently occupy the anterior mediastinum, and as a rule do not give any manifestation until later on in life — and that they are always found in the right side. Roentgenologically it is hardly possible to differentiate them from the ganglionic neuromata which also have their seat in the posterior mediastinum.

Of the 18 cases 11 were, as already mentioned, operated upon. Two of the cases were attended by complications (peptic ulcer with perforation) and the patients died on the operation table. One patient was treated with drainage only, extirpation was done in 8 cases, in 2 of which after previous drainage. 3 of these 9 patients died. This high mortality must be viewed on background of the fact that the patients were young children and that thoracic surgery and the anesthesia technique at the time at which the first operated cases are reported (1929—1933) were not so advanced as they are now. A consideration of the surgically treated cases in the last decade without complications (*i. e.*, not including perforations), shows that there is in 6 extirpations only 1 death — a four months old boy.

When considering the risk of perforation in the active gastrogenic cysts one should not in cases in which a tumor of the

posterior mediastinum has been recognized in a child wait too long before deciding on extirpation. With the thoracic surgery at the present level this surgical procedure should not be attended by any particular risk.

### Summary.

An operated case is reported of intrathoracic gastric cyst, and a brief review is given of the etiology, symptomatology and treatment of such cysts on basis of the 18 cases recorded in the literature up to now.

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## On the Surgical Aspect of Acute Hepatitis.

By

ERNST BERGENFELDT.

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The old theory of the pathogenesis of so-called catarrhal jaundice, presented by VIRCHOW in 1865, but now abandoned, assumed that there was an obstruction in the portio duodenalis choledochi — “Virchow’s mucous plug” — caused by a gastro-duodenitis which encroached on the common bile duct. The jaundice was explained as an entirely mechanical result of the biliary stasis induced by this obstruction. Modern research has led to a diametrically opposed conception, an extreme in the opposite direction. The pathologico-anatomic processes are now considered as taking place in the liver alone; *i. e.* catarrhal icterus is a hepatocellular disease, a hepatitis or hepatosis, the biliary ducts — or at least the external biliary ducts — being, as a rule, free from demonstrable pathological lesions. The intimate anatomical relationship existing in the liver between the parenchyma and the outflowing biliary ducts makes it *a priori* probable that an inflammatory process in either of these areas also causes changes in the other. GRAHAM (1918) in America, PETTINARI (1932) in Italy, and AAGERUP (1944) in Sweden have demonstrated that hepatic changes occur in practically every case of acute cholecystitis, in the majority of cases of chronic cholecystitis and even in a few cases of cholelithiasis. I shall now describe observations which, to my mind, indicate that, in cases of acute hepatitis, the biliary ducts as well — in one way or another — are involved, and that changes in them can play a part, if not for the pathogenesis of the disease, at any rate for its course and prognosis.

During an epidemic of hepatitis which occurred in the autumn of 1942, a 52-year-old woman was referred from the Medical

Department of the Västerås Hospital to the Surgical Department. She had suffered for five months from hepatitis with severe icterus, which did not respond to medical therapy. At the request of the physicians, who suspected a biliary obstruction, exploratory laparotomy was performed. Advanced changes in the form of a greatly enlarged liver, diffusely and finely nodulated on the surface, were revealed. After incision of the hepato-duodenal ligament, the external biliary passages were explored and palpated. Both these and the pancreas appeared to be normal. Since this was evidently a case of hepatic cirrhosis, and there were no indications of an obstruction in the biliary ducts, no further measures were taken. The jaundice persisted practically unchanged after the operation and the patient died 3 months later with signs of hepatic insufficiency. On autopsy the liver showed the picture of chronic hepatitis.

Shortly after the exploratory laparotomy performed on the previous case, another patient was referred to the Surgical Department with a practically identical clinical history. Severe icterus had been present for no less than 7 months. As in the former case, the liver was greatly enlarged, with a diffusely and finely nodulated surface. In order to exclude the possibility of an obstruction in the biliary ducts, cholangiography was performed during the operation. The common bile duct was punctured with a fine syringe needle, and the contrast medium injected. The biliary tree filled well and showed normal width; the medium also ran profusely down into the duodenum. The puncture opening was sutured with fine silk, a drainage tube was applied against the common duct and the abdominal wall sutured. Since there were severe liver lesions, we were pessimistic about the outcome in this case as well. However, to our surprise, shortly after the operation the jaundice began rapidly to regress. The bilirubin index in the blood serum (determined according to Meulengracht) sank, and four weeks later showed practically normal values. The patient was discharged as cured 6 weeks after the operation. On operating on her 2 years later for a hernia in the operation scar, the liver was found to be of normal size and the surface even and smooth and of normal consistency. The patient is still — 3 years and 9 months after the first operation — entirely well and fully capable of work. There has been no recurrence of the hepatitis. On the last re-examination the bilirubin index was 6 and the Takata reaction negative.

Due to the favourable results of the operation in the above

case, which was considered to depend on the perfusion of the biliary ducts, we decided to treat in a similar manner all such cases of acute hepatitis with long-standing severe icterus which show resistance to medical therapy. Altogether 7 such cases have up till now been treated by perfusion of the biliary ducts. In the first cases cholangiography only was performed, whereas in the later cases the biliary ducts were also perfused with Normal saline. In the majority of cases the injection was not made directly into the common bile duct — since this can sometimes be very narrow and difficult to puncture — but through an incision in the cystic duct, followed by removal of the bladder and ligation of the cystic duct. In one case the gall-bladder was punctured and filled with contrast-medium, after aspiration of the contents. By compression of the bladder, the medium was forced into the biliary ducts and down into the duodenum and Normal saline was then injected several times in the same way. Drainage tubes were inserted in the abdominal cavity, but as a rule it was possible to remove them after one or a few days. In all cases the biliary ducts were of normal width and contained no concretions. Moreover, the contrast medium ran profusely into the duodenum. *The effects of surgical intervention have been as remarkable in the 6 later cases as in the first case described above.* The jaundice regressed rapidly and the bilirubin values dropped, showing as a rule, a normal or practically normal index after 3—4 weeks. All the patients were discharged as healthy, and no relapses have occurred.

Table I gives a survey of the 7 cases operated on, with indications of the duration of the disease at the time of the operation; the bilirubin index (Meulengracht) at the same time; the size and other appearance of the liver during the operation, as well as the results of any biopsy examinations; the nature of the surgical intervention; the condition of the patient at the time of his discharge from hospital as well as his condition on re-examination.

The diagnosis of hepatitis was confirmed in two cases (III and IV) by microscopic examination of a biopsy specimen from the liver. In one case (I) such advanced hepatic lesions were found that an incipient cirrhosis was suspected. In cases V and VI also, such definite macroscopic lesions were found — a swollen, greatly enlarged liver, extending to respectively 2 and 3 finger-breadths below the costal margin — that there could be no doubt as to the diagnosis. In cases II and IV, the hepatic changes were somewhat insignificantly defined. The clinical course, however, in both

Table I.  
*Operation material.*

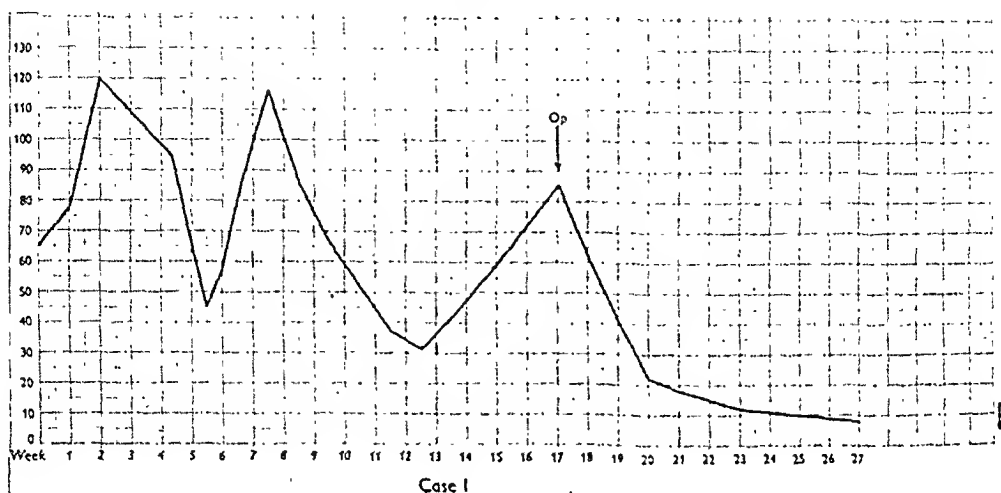
Journal No.	Sex Age	Duration of illness on operation	Meulengraecht index on operation	Size and appearance of liver on operation. Results of any biopsy examinations	Nature of operation	Time of discharge after operation. Condition.	Results of re-examinations
I (2088/1942)	♂ 57 years	7 months	85	Greatly enlarged; 3 fingerbreadths below the costal margin. Firm, small nodules on surface.	Puncture of common bile duct. Injection of contrast medium. Biliary passages free, narrow.	6 weeks. Healthy	Operation for rupture in scar 2 years after first operation. Liver of normal size and appearance. No relapse. 3 yrs. 9 months after first operation: Healthy. Meulengraecht index 6. Takata reaction negative. No enlargement of liver.
II (2184/1942)	♀ 58 years	5 weeks	180	Liver practically normal in appearance.	Cholangiography via the cystic duct. Biliary passages free, narrow. Cholecystectomy.	2 months. Healthy	3 yrs. 9 months after operation. Healthy. No relapse. Meulengraecht index 5. Takata reaction negative. No enlargement of liver.
III (2337/1942)	♂ 40 years	2 months	220	Greatly enlarged; reaching to the level of the navel. Biopsy examination. Histological findings: subacute hepatitis.	Cholangiography via the cystic duct + perfusion with Normal saline. Biliary passages free, narrow. Cholecystectomy.	3 months. Healthy	3 yrs. 8 months after operation. Healthy. No relapse. Meulengraecht index 5. Takata reaction negative. No enlargement of liver.

## ACUTE HEPATITIS.

IV (1291/1943)	♂ 48 years	6 months	141	Swollen liver.	Puncture of common bile duct. Injection of contrast medium. Biliary passages free, narrow.	Healthy	3 yrs. after operation. Healthy. No relapse. Meulengraecht index 5. Takata reaction negative. No enlargement of liver.
V (2146/1944)	♀ 42 years	10 weeks	100	Greatly enlarged. 3 finger-breadths below the costal margin.	Cholangiography via the cystic duct + perfusion with Normal saline. Biliary passages free, narrow. Cholecystectomy.	5 weeks. Healthy	1 yr. 10 months after operation. Healthy. No relapse. Meulengraecht index 5. Takata reaction negative. No enlargement of liver.
VI (1373/1945)	♀ 46 years	2 weeks	64	Greatly enlarged. 2 finger-breadths below the costal margin.	Cholangiography via the cystic duct + perfusion with Normal saline. Biliary passages free, narrow. Cholecystectomy.	3 weeks. Healthy	1 yr. 2 months after operation. Healthy entire first year after operation. 13 months later attack of abdominal pain with rise of bilirubin index (Meulengraecht) to 15. After 48 hours return to normal values. (New, slight hepatitis?) On re-examination healthy. No enlargement of liver. No jaundice. Takata negative. Meulengraecht 7.
VII (584/1946)	♂ 44 years	7 weeks	211	Enlarged. 1 finger-breadth below the costal margin. Biopsy examination. Histological findings: acute hepatitis.	Puncture of gallbladder. Injection of contrast medium, which was forced into the biliary passages. Free passage to the duodenum. Narrow biliary passages. Repeated perfusions with Normal saline.	6 weeks. Healthy	6 months after operation. Healthy. No relapse. Meulengraecht index 4. Takata negative. No enlargement of liver.



Diagram I.



Case I. Serum bilirubin values before and after operation.

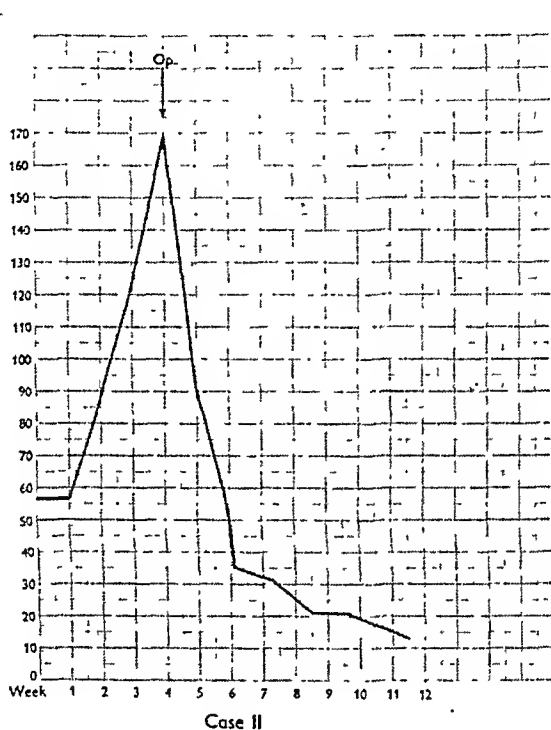
cases was typical of hepatitis. Both cases occurred during a widespread epidemic of hepatitis, cholangiography showed free, undilated biliary ducts, and the pancreas appeared, on operation, to be normal. An icterus of long duration with bilirubin values up to respectively 141 and 180 (Meulengracht) cannot, therefore, easily be explained otherwise than by the presence of hepatitis. Moreover, in both cases the diagnosis was supported by high citric acid values (39.3 microg. in Case II and 60 microg. in Case IV). I therefore consider that the diagnosis of hepatitis is certain in all 7 cases.

Diagrams I—VII show the bilirubin index in the blood serum (Meulengracht) before and after the operation in the various cases.

The common feature in these seven cases is a severe icterus on a hepatic basis, which — despite the usual medical therapy — persisted for several weeks or months, without any demonstrable obstruction in the biliary ducts. (Case VI, however, was operated on after only 2 weeks, on account of a suspicion of gall-stones. The operation showed free biliary passages and a marked hepatic enlargement of the liver.) After surgical intervention, which consisted of perfusion of the biliary ducts the jaundice regressed fairly rapidly. The bilirubin index in all the cases sank rapidly following the operation. This is shown in diagrams I—VII. Case I is especially noteworthy. Such severe hepatic lesions were

present that, on operation, the prognosis was considered to be extremely poor. Nevertheless, not only did the jaundice clear up and the patient recovered, but the liver changes also seemed to have completely disappeared. In any event, the patient is still, 3 years and 9 months after the operation, perfectly healthy. All the patients were re-examined and found to be completely restored

**Diagram II.**

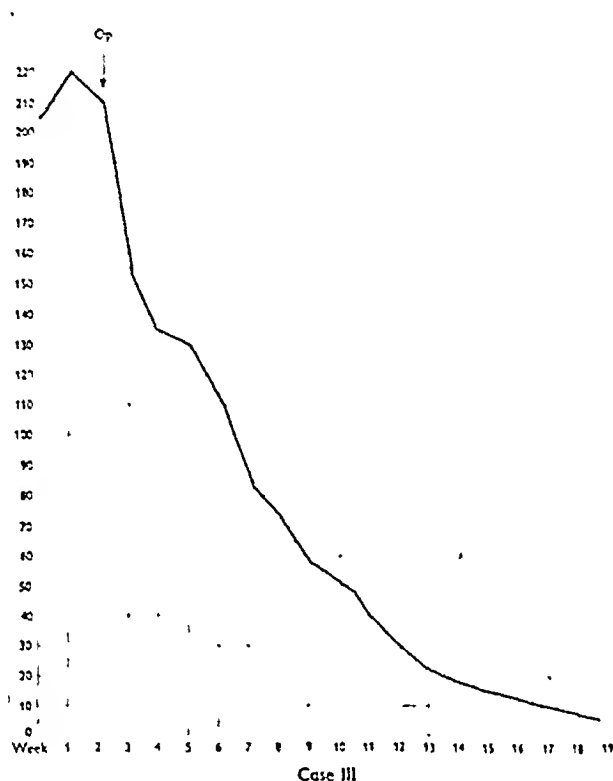


Case II. Serum bilirubin values before and after operation.

to health (see Table I). It is true that Case VI, 13 months after the operation, had an attack of abdominal pain with an insignificant rise of the bilirubin serum index of very short duration — it returned to normal after two days. Even if it were a question of hepatitis in this case, it was certainly a new, extremely slight attack. Since the patient had been entirely healthy for over one year after the operation, it could not have been a flare-up of the original hepatitis. Moreover, the enlarged liver had returned to normal size, and finally, the short duration of the new attack seemed to point to a fresh, mild infection. The other cases showed, on re-examination, no signs whatsoever of a relapse or a fresh infection.

How can we explain the obvious effect of surgical intervention in these cases? It is fairly certain that it cannot be a fortuitous coincidence between the operation and the regression of the disease. It is extremely unlikely that, in 7 cases in succession, the operation should be performed just at the moment when the

Diagram III.

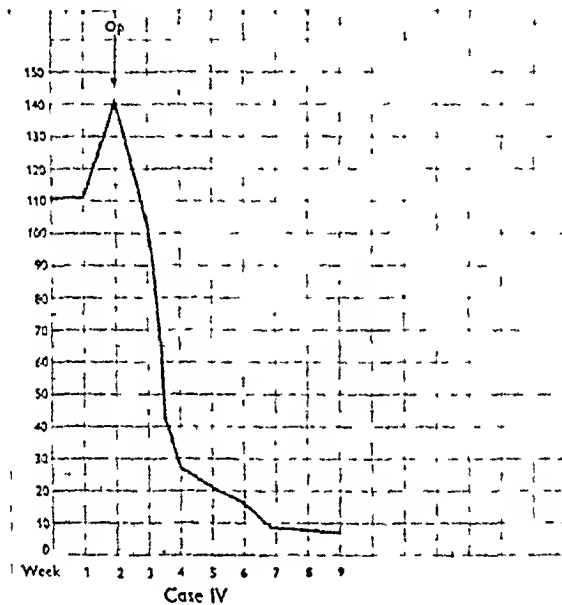


Case III. Serum bilirubin values before and after operation.

hepatitis had reached its peak and started to regress. A suggestion has been put forward that the exposure of the common bile duct excites vegetative nervous impulses in the vagus and sympathetic nerve fibres in the hepato-duodenal ligament. An increased flow of blood through the liver — analogous to a peri-arterial sympathectomy — would be brought about by the effect on the sympathetic nerve, and the stimulation of the vagus would then produce an increase in the secretion of bile, both processes then having a favourable effect on the hepatitis. If this assumption were correct, a post-operative improvement would also have been demon-

strable in the first case described, where the patient later died from hepatic insufficiency, and an exploratory laparotomy only had been performed. In this case as well, the biliary passages were exposed, examined and palpated. This could not take place without considerable manipulation of the hepato-duodenal ligament. Nevertheless, no drop in the bilirubin index occurred. The seven subsequent cases on which perfusion of the biliary ducts was per-

Diagram IV.



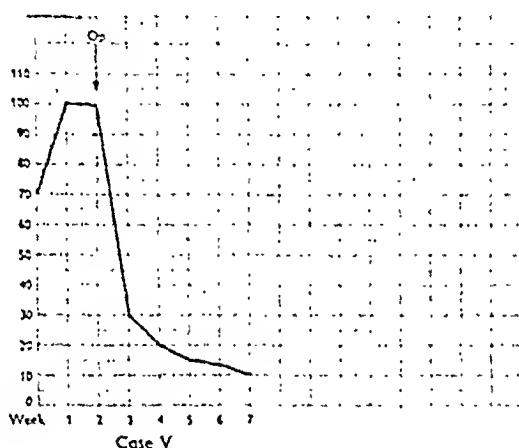
Case IV. Serum bilirubin values before and after operation.

formed present a considerable contrast to the previous cases. In all these cases, a considerable drop in the bilirubin index occurred following the operation; the jaundice regressed, and the patients recovered. Moreover, in one of these cases (Case VII) I endeavoured, as far as was possible, to avoid manipulation of the hepato-duodenal ligament. Neither the cystic duct nor the common bile duct was exposed, the fluid was injected into the gall-bladder after puncture of the fundus and was then forced, as described above, into the biliary passages and down into the duodenum. Although the hepato-duodenal ligament was scarcely touched, the effects of the operation were as evident in this case as in the others.

On the other hand cholangiography has shown, in all the cases,

that no large mechanical obstruction was present in the biliary ducts. In order to explain the effect of the operation, I have formulated the hypothesis that a *relative* obstruction existed in the lower part of the common bile duct, an accumulation of tough mucus, a cohesion of the mucosal surfaces, sufficient to obstruct the flow of bile, which — due to the hepatitis — had sub-normal pressure. This was then removed by the greatly increased pressure of the perfusion. This obstruction should not, however, be regarded

Diagram V.

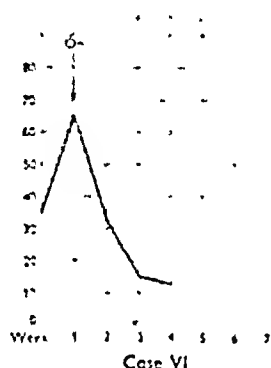


Case V. Serum bilirubin values before and after operation.

as the cause of the disease, but as a result or a complication of it. How are we then to visualize the pathologico-anatomical and physiological processes in such a case? Hepatitis is certainly the primary process. Toxic substances, perhaps even the virus itself are introduced into the bile through the inflammatory processes in the liver with destruction of the parenchyma. During its downward passage, the toxic bile stimulates the secretion of the mucous glands present in the biliary passages. Such glands are to be found partly around the opening of the cystic duct into the common bile duct and, especially, in the lowest part of the common duct, where they are particularly numerous. (There are also similar glands in the superior part of the hepatic duct but, according to ASCHOFF, their construction is not that of simple mucous glands but they are more branched, reminiscent of strangely differentiated biliary passages.) The pressure on the bile is subnormal, due to the hepatitis, and the relative obstruction of the accumu-

lated mucus in the orifice of the common bile duct can be sufficient to obstruct the flow of the bile into the intestine. The hepatitis is accentuated by the obstructed flow of the bile, the pressure decreases still further, and a vicious circle is thus formed. This vicious circle is broken by perfusion. Such a relative obstruction does not necessarily lead to a distension of the biliary passages. When the biliary pressure rises above a certain level, the bile seeps down into the intestine and the pressure is relieved. This hypothesis would explain the intermittent course with alternating acholia and presence of bile in the intestine, not infrequently

Diagram VI.



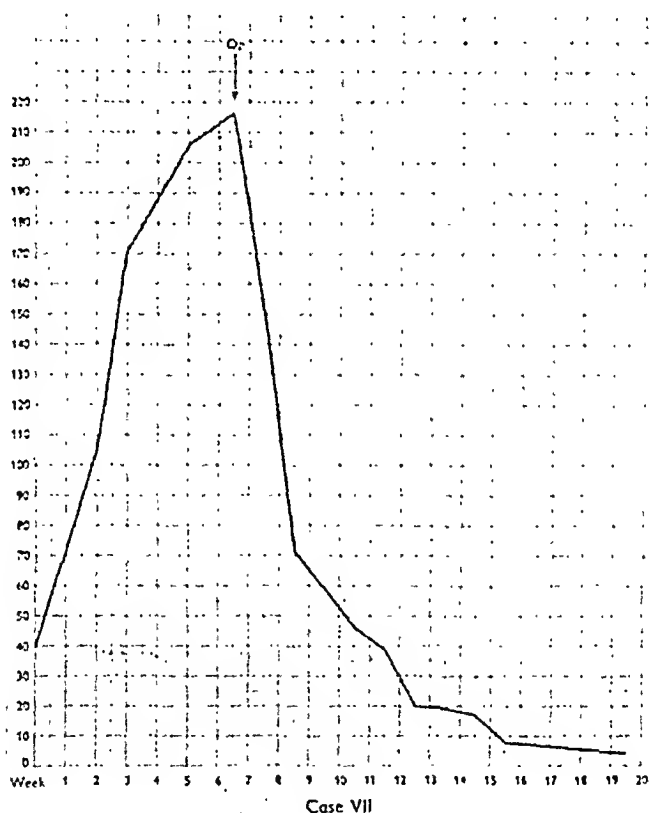
Case VI. Serum bilirubin values before and after operation.

typical of hepatitis. If the obstruction in the common bile duct is not removed by mechanical measures, the prognosis depends on the strength of the healing processes in the liver. If these prevail, the pressure in the bile rises and the mucus is emptied into the duodenum. If they do not prevail, the process can result in an acute hepatic insufficiency or a chronic condition with a resulting hepatic cirrhosis. All cases of hepatitis do not necessarily involve a marked secretion of mucus in the common duct. In cases with a hectic course with rapidly occurring acute yellow atrophy of the liver, this complication will probably not have time to arise, but in the long-term cases with long-lasting severe icterus — and it is these cases in particular which can be considered as suitable for surgical intervention — it is advisable to consider the possibility of the above condition.

It is probable that the changes in the liver itself affect the physiological processes sketched above by reason of their special

nature. According to ERRINGER, the hepatic inflammation causes a bursting of the biliary capillaries, which thus come into direct communication with the perivascular lymph spaces and the blood capillaries. It is thus possible to visualize the internal aspect of the liver as a sieve, with quantities of microscopic holes, through

Diagram VII.



Case VII. Serum bilirubin values before and after operation.

which the bile can empty into the lymph and blood passages. In this case, even an insignificant obstruction in the outflowing biliary passages would be sufficient to increase this backward flow and the occurrence of a vicious circle is easily understood here too. The fact that the bile has a possibility of escaping in this way should also hinder a dilation of the biliary passages.

I have received support for this hypothesis of a relative obstruction in the biliary passages by means of the following observations. In May, 1944, a 52-year-old woman was treated in the Medical

Department of the Västerås Hospital for acute hepatitis. Since the illness did not respond to medical therapy, and the jaundice — which had persisted for a month — was intensified and her general condition deteriorated, it was decided to transfer her, in the beginning of June, to the Surgical Department for operation. The bilirubin index (Meulengracht) had then (5/6) risen to 151. However, her condition became rapidly so bad that no operation could be performed and she died on June 6th in hepatic coma. I decided in this case to perfuse the biliary passages during the autopsy, using the same technique as in the former operations. The duodenum was opened and Vater's papilla exposed in order to observe whether any content flowed from the common duct on perfusion. The rest of the autopsy was performed by the pathologist of the Hospital, Dr. I. BEHRING, who made the following post-mortem report:

"Post-mortem observations: Diagnosis: Acute hepatitis. Cadaver of a middle-aged woman. Skin-colour markedly icteric. Muscles and adipose tissues normal. Usual post-mortem changes. Examination of the liver area alone was permitted by the relatives. After opening the abdomen with a small autopsy incision, the liver was examined. It was found to be considerably diminished in size. The surface was mottled with dark greyish-red areas, alternating with light yellow, irregular and diffusely delimited areas which were somewhat raised on the surface of the liver in comparison to the darker areas. The consistence of the liver was extremely flabby and doughy. After this preliminary examination, the biliary ducts were examined. The gall-bladder had a normal appearance and the wall was of normal thickness. It was practically devoid of bile and contained no concretions. The cystic duct was exposed and a cannula inserted. The common bile duct was not dilated. The duodenum was opened, to expose Vater's papilla. The mucous membrane of the duodenum was plentifully coated with mucus. Fluid was then injected through the cannula inserted in the cystic duct, *whereupon a large quantity of mucus was expelled from the orifice of the common duct at Vater's papilla.* No concretion was present in the common bile duct. The wall of the common duct showed no thickening and the mucous membrane appeared to be macroscopically unchanged. At the surface of the incision, the liver showed the same alternation of extended dark and sunken areas, and smaller, somewhat raised, light yellow to reddish-yellow diffusely delimited areas, similar to those found in the



examination of the liver surface. Palpation of the liver tissue revealed the presence of small nodules."

It can be added that, on perfusion, a somewhat firmer, plug-like formation issued first from the orifice of the common duct, followed by plentiful masses of loose mucus. When the biliary passages were incised after perfusion, no mucus remained in the common or the hepatic duct.

Since a post-mortem examination of human beings who have died of acute hepatitis is seldom performed, I have endeavoured to increase the material by autopsy examination of animals. Acute hepatitis, strongly resembling both in its occurrence and course that in man, occurs in pigs. Some scientists even consider that hepatitis in pigs and in man is caused by the same virus.

Through the courtesy of veterinary surgeons, I was able to perform an autopsy on a 6-months-old pig, which had died from jaundice after 6 weeks' illness. The autopsy was performed with the assistance of Mr. H. SJÖLIN, Veterinary Surgeon, Västerås. "The pig was strongly icteric. Greatly enlarged liver, partly nodulated on the surface. Aplasia of the gall-bladder. The common bile duct was narrow and collapsed. It was opened in the centre and showed only traces of light bile. A cannula was inserted in the biliary duct. On perfusion, which met with slight, but definite resistance, *a pea-sized plug of tough, insignificantly bile-coloured mucus was expelled slowly from Vater's papilla, followed by another similar plug of mucus, practically colourless.* The passage was then free and there was no feeling of resistance. (It is of interest to note that, before the plugs of mucus were expelled, water flowed from the papilla, evidently from beside the plugs.) The biliary passages were then incised. They contained no concretions and no other demonstrable changes were present." The diagnosis of hepatitis was verified by Dr. I. BEHRING, who — on microscopic examination of the liver — found an increase of fibrous tissue as well as marked degenerative processes in the parenchyma.

In a study of existing literature, we find that surgical treatment of acute hepatitis has earlier been attempted. The therapeutic principle has consistently been to relieve the strain on the liver by draining off the bile, either outwards by means of cholecystostomy or drainage of the common bile duct, or by internal fistulas. VON HABERER (1938) described 39 cases of operations for hepatitis, of which 37 recovered. In 2 cases VON HABERER made an internal

gall-bladder fistula, performed cholecysto-gastrostomy and choledocho-duodenostomy respectively, with satisfactory results in both cases. In two cases the common bile duct was drained, and in all the remaining cases a simple cholecystostomy was performed. In the same year NORDMANN published a report of 18 cases treated by drainage through the common duct, of which 15 recovered. FRANGENHEIM reported 10 successful cases out of 11. The treatment consisted of drainage through the common duct, sometimes combined with cholecysto-gastrostomy. BACKHAUS treated 7 cases by drainage of the common bile duct, satisfactory results being obtained in 5 cases. The favourable effect of this surgical intervention has generally been considered to depend on the removal of strain from the liver by draining off the bile. Provided that the biliary ducts really allow free passage, this explanation cannot be considered entirely satisfactory. This is particularly so in the cases where an internal biliary fistula was made and the body was thus not freed from the supposed toxic bile. My cases, in addition, show that the same satisfactory result can be reached without draining off the bile. However, the effect can very well be explained by the presence of a relative obstruction in the lower part of the common bile duct — an accumulation of tough mucus and a cohesion of the mucosal surfaces. Drainage of the biliary passages leads off the toxic bile whilst avoiding the obstruction, and the liver is given a respite to restore its functions and can then, by increased biliary pressure, force the accumulation of mucus out of the common duct. It is possible that, if a sound has been passed through the common duct during the course of the operation, this has contributed to the clearing of the biliary ducts. Another possible explanation is that a siphoning effect is induced by the drainage with a sucking-out of the mucus from the biliary ducts below the fistula opening. Repeated observations during the operations on these cases also appear to indicate the previous existence of such a condition with an accumulation of mucus in the common duct. VON HABERER writes (Dtsch. Zeitschr. f. Chir., 1933): "Anderseits grenzt es scheinbar ans Wunderbare, wenn bei solchen Kranken, die z. Z. schon im Zustande schwerer Somnolens operiert wurden, bei denen *aus den eröffneten äusseren Gallenwegen*, in denen und um die herum kein Hindernis zu finden war, *lediglich glasiger, wasserklarer Schleim sich entleerte*, mehr oder minder lange Zeit nach dem Eingriff plötzlich Sekretion richtiger Galle sich einstellt und von da ab der Zustand sich bessert, um

schliesslich in Heilung auszugehen." He also states: "BACKHAUS schloss aus der Beobachtung *weisser Galle in den extrahepatischen, hindernisfreien Gallengängen*, dass die Drainage der Gallenwege nicht entscheidend sein kann." As a result of KAUSCH's investigations (1911), we are aware that the occurrence of so-called white bile is caused by mucus produced by the biliary passages themselves (V. SCHMIEDEN and H. NIESSEN, Verh. dtsh. Ges. inn. Med. 1932). O. NORDMANN, too, states with regard to 4 cases described by him in 1925, that *no bile was found in the exposed common bile duct but that mucus (white bile) was present*.

Moreover, in reports of the successful treatment of acute hepatitis by means of duodenal intubation and perfusion with sulphate of magnesia solution, we find statements of the removal of mucus and other inflammatory products from the common bile duct. BRULÉ (1934) and his co-workers, who described 5 such cases, are of the opinion that this is a special form of disease, where an obstruction in the lowest part of the common duct, probably of inflammatory origin, is the cause of the jaundice. This obstruction is removed by the duodenal intubation. In one of the cases (of which a report was earlier published by HARVIER and ANTONELLI), where a severe icterus had been present for 90 days, very light bile, with a large percentage of mucus, was obtained on the first duodenal intubations. The subsequent intubations produced successively darker bile, the presence of mucus disappeared, and the patient recovered.

I. MATSUO and N. MIZUTA describe two cases of long-standing, severe icterus, where, by duodenal intubation (with perfusion with magnesium sulphate solution) a membrane, which apparently consisted of a cast of the common bile duct, was sucked up. The jaundice then regressed very rapidly in both cases, and the patients recovered. At the annual meeting of the Swedish Surgical Association in 1943, H. HULT in a discussion described a case of hepatitis with long-standing acholia in which, after perfusion with magnesium sulphate through a duodenal sound, a plug of pus had first been obtained, and following it, clear, greenish-black bile. A rapid improvement, with a drop in the bilirubin index followed this intervention. The favourable effect in some cases of duodenal perfusion with magnesium sulphate solution can hardly have any other explanation than that an obstruction of some kind is hereby removed from the common bile duct.

Manifold evidence thus exists that acute hepatitis can occur with formation and accumulation of mucus in the common bile duct. Thus the most obvious explanation of the effect of surgical intervention in the form of perfusion of the biliary passages is that it removes the accumulation of mucus and re-establishes free passage through the biliary ducts, and, as a result, the relative obstruction in the form of the accumulation of mucus can have a decisive effect on the course and the prognosis of the disease. Assuming this hypothesis to be correct, how should one account for the fact that no further accumulation of mucus occurs subsequent to perfusion? One possible explanation may be that during the early, acute stage of hepatitis the bile is rich in toxins which stimulate the mucus glands in the common bile duct to secrete mucus in the manner already described. Once the acute stage is passed, and the liver is recovering, the quantity of toxins in the bile diminishes, ultimately to disappear altogether. When an operation is performed at an advanced stage of the disease there should be no reason to expect further secretion of mucus. The accumulation of mucus having been removed, the relative obstruction of the discharge ceases and the disease regresses rapidly. How does the hypothesis agree with the results of the modern liver function tests — the serum citric acid test (Ci/s) and the serum phosphatase test (Fo/s)? Since a rise in the serum citric acid is interpreted as an indication of hepatitis, and a rise in the serum phosphatase as indicative of an obstruction in the biliary passages, we can expect — in the case of hepatitis with a relative obstruction in the common duct — a distinct rise in the citric acid index, as well as a rise of the phosphatase — probably a moderate rise only. A rise in the serum phosphatase should not occur in the early stage of the disease, but only when the changes in the biliary passages have had time to develop and become pronounced. In order to ascertain these circumstances, I have studied the hepatitis material from the Medical Department of the Västerås Hospital during a 3-year period, 1942—45. The material comprises 193 cases. Serum citric acid and serum phosphatase determinations were, however, only made in severe and long-standing cases, altogether 62. 7 cases with simultaneous diabetes can be excluded, since diabetes in itself can cause a rise in the serum phosphatase. Of the remaining 55 cases (Table II) only 12, *i. e.* 21.8 %, had normal serum phosphatase values, between 2—8 units (Buch), whilst 43, *i. e.* 78 %, showed raised values. 9 cases had values between 8.1—10 units,

23 cases between 10.1—15 units, 8 between 15.1—20 units and 3 cases above 20 units. It is noteworthy that so large a percentage as 78.2 showed raised values. BUCH, who worked out the method for serum phosphatase determination, states in his monograph that 50 % of his cases of certain hepatitis showed raised phosphatase values. The high figures in my material are probably due to the fact that the tests were only made in cases which were severe and long-standing. At what stage the rise in the phosphatase values occurred I cannot state, but BUCH states that the rise occurs at a relatively late stage of the disease. J. LEHMAN fixes a borderline for the values at 20 units. In hepatitis, the phosphatase index lies as a rule *under* 20 units, but in icterus, due to a true obstruction in the biliary passages (gall-stones, cancer) it is often over 20 units.

Table II.

*Serum phosphatase values in hepatitis material 1942—45. (Normal values 2—8 units.)*

Fo/s	No. of cases	%
2 — 8 units . . . . .	12	21.8
8.1—10   > . . . . .	9	16.4
10.1—15   > . . . . .	23	41.8
15.1—20   > . . . . .	8	14.5
> 20       . . . . .	3	5.5

Table III.

*Serum citric acid values (normal 20—28 micrograms) and serum phosphatase values in the cases operated.*

Cases	Ci/s	Fo/s
I . . . . .	29.9 microgram	18.6 units
II . . . . .	39.3   >	10.3   >
III . . . . .	31.6   >	20.8   >
IV . . . . .	60       >	8.6   >
V . . . . .	42.3   >	7.6   >
VI . . . . .	70.2   >	23.8   >
VII . . . . .	44.3   >	9.2   >
791/1944	46.5   >	20.2   >

If we now consider the 7 cases in which operation was performed, (Table III) we find, it is true, one case with a phosphatase index within the normal limits, 7.6 units. However, on re-examination some months after the operation, the value was only 3.4 units, and the previous value can therefore perhaps still be regarded as increased. In the 6 remaining cases, there was a distinct rise; in 3 of these a very distinct one, two showing above 20 units. Finally, at the bottom of the table we find a case with a phosphatase index over 20 units. This was the patient on whom it had been intended to operate, but who died prior to operation in hepatic coma. On autopsy, as described above, a plug of mucus was found at Vater's papilla as well as large quantities of looser mucus in the common bile duct, but no gall-stones or any other true obstruction. In this case it is practically impossible to avoid the assumption that the rise in the phosphatase index was caused by the relative obstruction in the form of the accumulation of mucus.

The investigation has thus shown that hepatitis is often accompanied by a rise in the serum phosphatase values. Assuming that this rise is an indication of an obstruction in the biliary passages, this supports the hypothesis of a relative obstruction in the common bile duct. At any rate, the results of the phosphatase tests do not contradict this hypothesis.

Apart from the question as to whether the hypothesis put forward in this paper regarding the pathogenesis of acute hepatitis is correct or not, the effect of surgical therapy is so evident that there is reason for surgeons to adopt a more active standpoint than hitherto in the treatment of this disease. It is true that hepatitis is most frequently a relatively benign illness which regresses in the course of a few weeks with suitable medical therapy, and *such cases naturally do not fall within the scope of the surgeon*. Occasionally, however, cases occur of stubborn severe icterus which persists for weeks or months, not infrequently resulting in acute yellow atrophy or cirrhosis of the liver with hepatic insufficiency. There is reason to believe that active surgical therapy can save a number of these patients. Perhaps, too, the number of cases which, after hepatitis, are predisposed to chronic hepatic cirrhosis in later life can be reduced by suitably timed operations. As regards the indications for surgical intervention, the cases may be divided into two groups. Cases in which the diagnosis is uncertain belong to the first group. Despite all the modern tests of liver function, it is often difficult to differentiate between hepa-

titis and obstructive icterus. Doubtful cases should be operated on. Cholangiography gives a rapid and reliable picture of the situation.

Cases of certain hepatitis with severe icterus which does not regress within a reasonable period of time belong to the second group. It is, naturally, impossible to state the exact time at which the operation should be performed. The course of the disease and the condition of the patient are the criteria. Even severe cases should first be treated medically, possibly combined with perfusion with magnesium sulphate through a duodenal tube. Only when this treatment does not yield the desired results should operative treatment be decided on. It is, however, important that surgical intervention should not be delayed until irreparable hepatic damage has arisen. The condition can sometimes become serious very suddenly and it is often impossible at any early stage to predict the prognosis in individual cases. Complete acholia with simultaneous deterioration in the patient's general condition should be regarded as alarming symptoms.

The operative measures should in the first place consist in cleansing the biliary passages, best done by perfusion. If changes in the gall-bladder are found — stones, chronic cholecystitis — cholangiography should be performed as usual through the cystic duct, followed by perfusion and removal of the gall-bladder. If the gall-bladder appears to be normal, the contrast-medium is injected into it and forced out into the biliary ducts. Perfusion with Normal saline is then carried out in the same way. Should it prove impossible to force the injected medium into the biliary passages — which may depend on a pathological cystic obstruction, not demonstrable externally — removal of the gall-bladder is justified. Cholangiography and perfusion are then carried out via the cystic duct. Another possibility — if the common bile duct is sufficiently wide — is to puncture it and perform the cholangiography and the perfusion directly through it.

It is essential, if the operation is to be performed, for the prothrombine index to be sufficiently high. Should this not be the case, K-vitamin should be given in sufficient quantities to bring it up to normal and K-vitamin therapy should be continued post-operatively.

### Summary.

The writer describes 7 operated cases of acute hepatitis, where the jaundice was not relieved by medical therapy. The surgical

treatment consists of perfusion of the biliary passages with the contrast matter for cholangiography, supplemented by perfusion with Normal saline in certain cases. The jaundice disappeared rapidly following this treatment and the patients recovered. No relapses occurred and all the patients were still in good health on re-examination — in the first case described 3 years and 9 months after the operation. To explain the effects of the surgical intervention, the author puts forward the hypothesis of a relative obstruction consisting of an accumulation of tough mucus, an adhesion of the mucous surfaces, in the lower part of the common bile duct. This is sufficient to obstruct the flow of bile, which is under sub-normal pressure due to the hepatitis. The obstruction is removed by the increased pressure caused by the perfusion. The hepatitis is accentuated by the impeded flow of bile, the pressure drops still further and a vicious circle develops. This is broken by the surgical intervention. The writer stresses that this relative obstruction in the common bile duct must not be considered as the cause of the disease, but as a result and a complication of the hepatitis.

In support of this hypothesis, the writer gives the post-mortem findings on a patient who died of acute hepatitis. When the biliary passages were perfused during the autopsy, a somewhat firm plug of mucus was expelled from Vater's papilla, followed by large quantities of loose mucus. Similar findings were made in the post-mortem examination of a pig which had died of acute hepatitis. VON HABERER, BACKHAUS and NORDMANN state that mucus was present in the common bile duct of several of the patients suffering from hepatitis on whom they had operated. In reports of successful treatment of hepatitis by duodenal intubation and perfusion with magnesium sulphate solution, we find an account of the expulsion of mucus and other inflammatory products from the common bile duct. Finally, in the opinion of the writer, the results of modern tests of the liver function — the serum citric acid test and the serum phosphatase test — also support the proposed hypothesis. The writer considers that, on the grounds of the evident satisfactory effect of surgical therapy, surgeons should take up a more active standpoint than formerly in the treatment of acute hepatitis. The operative therapy should in the first place consist in cleansing the biliary passages. This is most satisfactorily achieved by perfusion.



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## Anorectal Malignant Melanomas.

A clinical study based on two cases.

By

OLLE MÜLLER.

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The term malignant melanoma covers tumours containing a greater or smaller amount of the iron-free pigment melanin, and presenting all the characteristics of a malignant tumour. They are called melanosarcoma, melanoepithelioma, melanoperithelioma, melanofibrosarcoma or melanocarcinoma according to the variations in the histological picture. Clinically and histogenetically these tumours are all identical, and the differentiated terminology therefore seems scarcely warranted. VIRCHOW suggested melanosarcoma carcinomatodes as a common term for these tumours, but in modern literature we find the name malignant melanoma increasingly frequently applied to these tumours. This is a clinical term, which seems quite adequate histologically also.

Malignant melanoma is fairly common in the skin and chorioid, less common in the central nervous system, and the meninges, and fairly rare in the vulva and rectum. According to OBERNDORFER they do not primarily occur in other parts of the intestine than the rectum, where they are mostly found in the region of the anus. The few melanomas in the small intestine and cecum, described in the literature, are, according to OBERNDORFER, very probably to be regarded as metastases. About 80 cases of malignant melanoma situated in the rectum are found in the literature, and the disease is consequently to be looked upon as fairly uncommon. MARINO (1934) states that they make up 2

to 3 per cent of all malignant melanomas but 66 per cent of all sarcomatous tumors in the rectum. CORNER & FAIRBANK (1904) found 7 rectal cases in a material of 175 cases of various kinds of sarcomas, including melanosarcomas in the digestive tract, HOCHENEGG (1908) found 6 melanomas among 560 malignant tumours in the rectum, and KEY (1905) had 2 malignant melanomas among 206 carcinomas. Up to 1938 the total number of published cases was 86, 8 of which, however, were not verified. Owing to the varying terminology employed previously, there seems to be a certain confusion as to the classification of these tumours. GERRITZEN (1934), for instance, collected 72 cases of melanosarcoma in the rectum from the literature. However, only 48 of these are to be counted as primary rectal sarcomas, the remaining ones being classified as melanocarcinomas and included among the anal tumours. In 1937 HASHIMOTO collected 58 malignant melanomas from the literature, including one case of his own.

With respect to age distribution, the following figures may be quoted from OBERNDORFER, who sets the mean age at about 50 years; he states that the same figure for sarcomas is only 37 years.

All statistical data regarding the sex distribution in malignant melanomas indicate that these tumours are most frequent in men. OBERNDORFER sets the ratio of men to women at 18:10, while other authors report a proportionately higher percentage of male cases. The highest figure, 92 per cent, was found by SCHÜMAN.

Histologically the anorectal malignant melanomas correspond on the whole to those situated in other organs. The tumour cells are often polymorphic. The most frequent finding is spindle-shaped or round cells, but structures resembling those found in endo- and peritheliomas as well as carcinoma-resembling cell formations are also often found — they may even occur within one and the same tumour. Melanin is found between or within these cells; the amount of melanin may also vary within wide limits both as regards to quantity and mode of appearance. Within different tumours — or different parts of the same tumour — pigment may thus be found in single granules or massed into large plaques; on the other hand, pigment may be lacking completely. The general rule seems to hold that there is more pigmentation in the tumors situated nearest the anus, while those

located higher up in the rectum are relatively poor in pigment. With regard to metastases the tumors become increasingly malignant in proportion to their lack of pigment and of differentiation.

The highly varied histological picture of the malignant melanoma explains the conflicting opinions prevailing among the investigators as regards the histogenetical determination of its nature. It is beyond the scope of the present paper to survey in detail the discussion of the histogenesis of a melanoma — this belongs to the field of pathological anatomy, and I therefore restrict myself to mentioning only the most important contributions to this discussion. In his monograph "The Melanomata", DAWSON summarizes the works which have introduced new aspects into the discussion. The great interest which has been given to this question is illustrated by the fact that men like VIRCHOW, LAËNNEC, v. RECKLINGHAUSEN, UNNA, LUBARSCH, RIBBERT and MASSON are found among the contributors to the debate, often defending diametrically opposed points of view. The central question has been whether the tumour cells derive from ecto- or entoderm, and if they should consequently be classified as carcinomas or as sarcomas. It seems by now to be verified that they derive from the cells which normally have the capacity of forming melanin, *i. e.*, the melanoblasts. Another type of cells, the chromatophores within which melanin sometimes is found, probably do not possess this capacity, although they are capable of conveying melanin. The melanoblasts derive from the ectoderm, and the opinion that melanomas derive from ectodermal tissues has steadily gained ground. The question is complicated by the fact that ectodermal tissue, *e. g.* in the form of nervous tissue, is found in almost all organs. Even if some authors have launched the term chromatophoroma, it seems at present to be proved fairly conclusively that the matrix tissue of these tumours is ectodermal, and that the melanoblasts are capable of dissociating from their original location. Disconnected from their earlier surroundings, these undifferentiated cells would thus possess possibilities for a continued development in one or the other direction. This might explain the highly varied histological appearance of the tumors in their final form. — The question of their genesis is further complicated by their location in the rectum, as this has been considered to indicate that melanomas are of sarcomatous nature. As pointed out above, these malignant

melanomas are, however, most frequently located anorectally or have at least their origin rather far anally in the rectum even if they may expand in an oral direction in their further development. It is a wellknown fact that the limit between the squamous epithelium of the anal region and the glandular epithelium of the intestine is not well-defined; parts of the squamous epithelium may extend far up in the rectum. It is also possible that, in cases of proctitis with ulceration of the rectal mucous membrane, healing may take place in the form of proliferation of islands of squamous epithelium (OBERNDORFER). — The malignant melanomas in the skin derive as a rule from congenital pigment spots or from the more diffuse pigmentations known as melanosis. Anorectal melanomas, too, probably arise in melanotic areas, although for obvious reasons this cannot always be proved.

The clinical picture is to a certain extent characteristic. A malignant melanoma generally appears as a solid, more or less prominent, sometimes almost polypous tumour which in time fills up the rectal lumen. There is no tendency to circular growth, but considerable infiltrations may be found in the rectal wall. Isolated lymphogenic metastases may also occur in the neighbourhood. The tumours often bleed easily, but the ulcerations are superficial. There is no tendency to necrosis and crater formation.

There is naturally a marked correspondence between rectal carcinoma and anorectal malignant melanoma based on the symptoms. Frequent straining at stool, tenesmus and haemorrhages dominate the picture in both conditions. In cases of malignant melanoma prolapse of the tumour is not seldom a significant symptom. The patient has a feeling of a foreign body in the rectum due to the tumour, whose growth is mainly exophytic. In more advanced cases the passage may become difficult, not owing to stricture as in carcinoma, but to the size of the tumour, which leaves insufficient space for the contents of the intestine.

From the point of view of differential-diagnostic carcinoma is the condition with which malignant melanoma is most easily confused. However, due to its tendency to circular growth and crater formation, rectal carcinoma presents a different clinical appearance. This is also true to a certain extent of anal carcinoma. The condition may also be reminiscent of malignant degenerated rectal polypus, but in this connection, it should be pointed out that a malignant melanoma does not as a rule present any markedly

polypous appearance. Sometimes it is also difficult to make a differential diagnosis with respect to thrombotized haemorrhoids. The location, palpation findings in the case of an early tumour, appearance and symptoms may be rather similar in these two anal complaints and the danger of such a mistake, disastrous to the patient, has been pointed out in the literature (ALLEN, MARINO et al.). The diagnostic difficulties with regard to the infrequent sarcomatous tumours of other kinds are unimportant and may be disregarded. Even if our suspicions point in a definite direction after considering the various possibilities mentioned above, the diagnosis "malignant melanoma" can often not be definitely ascertained until after microscopical examination. However, if pigmentation of the tumour or the surrounding mucous membrane can be observed at rectoscopy, it should be possible to make the diagnosis solely on the basis of the clinical findings.

Malignant melanoma exhibits a pronounced tendency to metastasize. CHURCHMAN observed metastasis in the liver in 87 per cent, and in the lungs and pleurae in 50 per cent. Metastases in the inguinal lymph nodes on the other hand, are not so common as in the retrorectal nodes. With generalization of the tumour, there may, in rare cases, be a pigmentation of the skin, probably via the suprarenal glands (ODEL, MONTGOMERY & HORTON).

The treatment of a malignant melanoma in the rectum is often a most thankless task. Because of the meagre symptomatology in the initial stages of the disease, the patients come to treatment at a late stage and this, together with the pronounced tendency to development of metastases, contributes to the poor prognosis. Radiosensitivity is generally slight, though exceptions have been reported. One case, treated by WILKIE and reported in a paper by LINDNER & WOOD, was judged to be inoperable, but was subjected to repeated roentgen and radium series. After three years the patient was still free from symptoms. The main therapy of anorectal malignant melanoma is surgery, however, and owing to the often insignificant infiltration of surrounding tissues, the primary tumour is well suited for radical excision. It has very rightly been pointed out that the operation should be as radical as possible and that the regional lymph nodes — in this case the retrorectal ones — should be removed, too. HANDLEY has stressed the necessity of a careful dissection of the lymph nodes even if they show no clinical signs of tumour growth. The prognosis

in cases of malignant melanoma is on the whole bad. According to DURANTE the mortality in cases operated upon at an early stage amounts to no less than 78 per cent, while the 5-year cure rate is not more than 13.1 per cent. As mentioned above, radiological treatment alone is as a rule of little avail owing to the low radiosensitivity of the melanomas. Radiotherapy is, however, advisable as a complement to radical excision; it should preferably be administered both before and after the operation and directed at both the rectum and the groins.

Two cases of anorectal malignant melanoma have been treated recently at the Radiotherapy clinic in Lund. As they offer several points of interest, they will be summarized below.

The first case was a 56-year-old man. On admission in January 1944 he had had symptoms for about 6 months. The disease began with pains in the anal region and prolapse of one nodule through the anal ring on defecation. Later haemorrhages set in. The patient has seen a physician twice — on both occasions the diagnosis haemorrhoids had been made — before he was admitted with the diagnosis rectal tumour. Enlarged inguinal lymph nodes had been observed about 3 months previous to admission. There had not been any obstacle to the passage of the feces nor any change in their form. On admission the patient was found to be in good general condition. Movable lymph node metastases, the largest of which were walnut-sized, were found in both groins. Immediately inside the sphincter an irregular well limited tumour was found, consisting of 4 to 5 hazel-nut-sized nodules, originating from one common basis. Not far from this larger tumour a small subepithelial metastasis was observed; no further metastasis could be observed either clinically or roentgenologically. The palpation findings differed in several respects from those of a rectal carcinoma; a biopsy was made and the suspicion of a malignant melanoma was confirmed. No distinct pigmentation of the tumour or its surroundings could be observed at rectoscopy. Roentgen was at first administered as preoperative treatment, but as the patient returned after a short time obviously improved, it was considered more suitable, in view of the poor prognosis to refrain from operation and instead to try to achieve a palliative effect by means of continued radiological treatment, especially as the primary tumour and the metastases had been found to be unusually radiosensitive. Continued roentgen therapy combined with local application of radium brought about further improvement, and five months after admission the primary tumour had disappeared and the metastases had further diminished. There were still no metastases in the lungs or skeleton. Eight months after the beginning of the treatment the patient was again admitted to hospital, owing to pains caused partly by a necrosis in the tumour region and partly by a local recurrence. As further radiotherapy now was considered useless, attempts were made to produce permanent spinal anaesthe-

sia. Shortly afterwards the patient died in his home. No autopsy was performed.

The second case was a 38-year-old woman, who for a long time had suffered from chronic obstipation which had been more pronounced during 1944. In April 1944 she observed a small bleeding nodule protruding through the anus. The patient interpreted her symptoms as due to haemorrhoids. Rectal pain and mucous excretion caused her to visit a physician who made a biopsy. This showed a medullary carcinoma with tendency to papillary formation, numerous mitoses and necrosis. She was admitted to the Surgery clinic in Lund in September 1944. After colostomy had been performed the patient was transferred to the Radiotherapy clinic for preoperative irradiation. A slightly more than plum-sized tumour with short stalk, the thickness of a finger, was found just inside the sphincter and, to the left of the basis of the stalk, a tuberous infiltration. Large and fixed lymph node metastases were observed in both groins. The fairly well limited tumour, which was not ulcerated and grew relatively superficially, did not resemble a carcinoma but instead a malignant melanoma. When at rectoscopy pigmentation was observed near the base of the tumour, this further confirmed the suspicions of melanoma. Roentgen therapy was applied to the rectum and groins, after which the patient was operated upon. In the first stage the primary tumour was removed, and then the inguinal lymph nodes were dissected. Microscopical examination of the entire tumour showed a malignant melanoma, which in many respects resembled a carcinoma. Other parts of the tumour gave a more sarcomatous impression. The tumour consisted of large irregular cells with large bright nuclei and distinct nuclear bodies. A large amount of a rather coarsely granulated brown pigment, which proved to be melanotic, was found in the tumour cells as well as in the chromatophores in the stroma. A couple of hazelnut-sized lymph node metastases, which contained large amounts of melanotic pigment, were detected in the perirectal fatty tissue. Histological examination also revealed metastases in the inguinal lymph nodes that were removed.

The last time the patient was observed — June 1945 — recent inoperable metastases were found in one groin. Roentgen treatment was then applied.

The patient became worse in spite of x-ray treatment and died in November 1945 in a state of multiple metastases. No autopsy was performed.

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The present two cases illustrate the difficulties but also the possibilities of differential diagnosis between carcinoma and malignant melanoma in the rectum with the aid of the symptomatology as well as palpation. The symptom picture in the first case presents a trait which is atypical for carcinoma, viz. prolapse of the tumour and absence of passage obstacles, and further the presence of a pedunculated tumour, growing mainly exophytically



without any tendency to circular infiltration or to central necrosis. In the second case there are less anamnestic differences with respect to carcinoma, but palpation, as well as the observations at rectoscopy, awoke suspicions of malignant melanoma in spite of a carcinoma being diagnosed microscopically. This case also demonstrates the difficulties of microscopical examination, which sometimes reveals a picture greatly reminiscent of carcinoma.

### Summary.

After a brief survey of the literature concerning the histology and pathology of malignant melanoma, the author gives a description of 2 cases of malignant melanoma localized in the anorectal region. The possibilities of making a differential diagnosis, with the aid of certain characteristic clinical discoveries, between malignant melanoma and other tumours, especially cancer, within this region, are pointed out.

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From the Surgical Clinic, Lund.  
(Chief: Professor J. P. STRÖMBECK.)

## The Value of Post-operative Dicoumarin Prophylaxis at "Early Rising".

By

STIG BORGSTRÖM.

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STRÖMBECK recently pointed out,<sup>1</sup> that from available statistics a decrease of the post-operative thrombo-embolic frequency at early rising is found to be at least 1/3 of that in comparison materials from earlier periods (BACKER-GRÖNDAHL, 1944, DAHL-IVERSEN, 1945, WESTERBORN, 1946). By dicoumarin prophylaxis BRUZELIUS (1945) shows a decrease of the thrombo-embolic cases at the Surgical Clinic in Lund to 30—39 % of the frequency calculated for the preceeding years. The lower figure, 30 %, is obtained when comparison is made to the number of thrombo-embolisms during the years 1930—39, the higher, 39 %, when comparison is made to the frequency during the years 1940—42. During the former period no water therapy in modern sense was given and the patients stayed in bed comparatively long after operation. During the latter period water therapy had begun to be introduced, and the patients got up a shorter time after operation.

On an operated material early rising thus seems to be able to decrease the thrombo-embolic frequency to at least the same extent as dicoumarin prophylaxis. In the investigation, of which an account will be given below, the questions to answer have been: Can prophylactic dicoumarin treatment give operated patients treated with early rising any other protection against thrombo-embolic complications or is it unnecessary?

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<sup>1</sup> Lecture in Helsingfors in January, 1947: Attempts at a valuation of the various modern methods of the prophylaxis and therapy of the thrombo-embolism.

### The composition of the material.

In order to answer these questions all those at the Surgical Clinic in Lund during 1946 operated patients, admitted to the hospital, who were 25 years of age or older, were divided into two groups according to their journal numbers. Patients with odd journal numbers, 940 cases, were in principle to obtain dicoumarin prophylaxis, those with even numbers, 891 cases, on the other hand not. When the function of the liver is failing or when the stilling of the blood operation-technically is unsatisfactory, dicoumarin treatment is considered to be counter-indicated. After each operation the narcotist asks the operator, who does not know the patient's journal number, if dicoumarin is counter-indicated. The operator's answer is taken down into the narcosis journal. From table 1 it appears that for men, 25 years of age or older, dicoumarin has been considered to be counter-indicated in  $19.2 \pm 1.31$  %. For women in corresponding age the figure is  $15.5 \pm 1.19$  %. The difference,  $3.7 \pm 1.77$ , is not significant. If these groups are taken together, one finds that dicoumarin is counter-indicated in  $17.3 \pm 0.88$  % of the operated cases in question. In table 1 the included material has also been divided up into odd and even journal numbers. In this way control can be obtained that the operator has not let himself be influenced by the patient's journal number, when he has stated, if dicoumarin should be counter-indicated or not. One also finds a good correspondence in the percentual number of counter-indicated cases in corresponding groups with odd and even journal numbers.

Thrombo-embolic complications in the post-operative course might be very rare among the age groups under 25 years, and no such has occurred at the Clinic during 1946. They have therefore not obtained dicoumarin prophylaxis and are consequently not included, as has been pointed out earlier, in the material presented here. They have, however, been entered into table 1, in order that one may be able to make a comparison with the thrombo-embolic frequency in other materials, where all the operated cases have been included. Besides to the patients, where the operator has considered dicoumarin counter-indicated, dicoumarin prophylaxis has not been given to a further few with odd journal numbers (table 2). It has been partly in operations of the thyroid gland, partly in various small operations,

Table 1.

	Number of operated cases	Operation counter-indicates dicoumarin		Number of operated cases					
				Odd journal numbers			Even journal numbers		
		Number of cases	%	Number of cases	Operation counter-indicates dicoumarin		Number of cases	Operation counter-indicates dicoumarin	
					Number of cases	%		Number of cases	%
Men $\geq 25$ years	900	173	19.2	457	87	19.0	443	86	19.4
" < 25 "	296	14	4.7	134	3	2.2	162	11	6.8
Women $\geq 25$ "	931	144	15.5	483	78	16.1	448	66	14.7
" < 25 "	250	15	6.0	124	7	5.6	126	8	6.3
Total $\geq 25$ years	1,831	317	17.3	940	165	17.6	891	152	17.1

where the risk of thrombo-embolic complications has been considered to be very small, and in the cases who have died, before the prophylactic treatment could be set in.

Table 2.

Odd Journal Numbers.						
	Men			Women		
		Thrombo-embolisms			Thrombo-embolisms	
		Number	%		Number	%
	Number of cases . . . . .	457	18	3.9	483	11
Dicoumarin treated cases . .	337	10	3.0	364	6	1.7
Dicoumarin counterindicated cases . . . . .	87	8	6.7	78	5	4.2
Other non-dicoumarin treated cases . . . . .	33			41		
Even Journal Numbers.						
Number of non-dicoumarin treated cases . . . . .	443	20	4.5	448	30	6.7

If the material is divided into prophylactically dicoumarin treated and non-dicoumarin treated cases, one finds (table 2) that 337 men and 364 women belong to the former group, whereas 563 men and 567 women are to be assigned to the latter. In order to establish, if possible, in what measure these two groups are comparable, four factors, which are particularly considered to influence the thrombo-embolic frequency, have been examined; the age of the patients, the post-operative duration of the time of stay in bed, the weight of the patients, and the distribution of various operations.

### The age of the patients.

In the calculation of the distribution of age within the dicoumarin and non-dicoumarin treated groups respectively, the material has been divided into age periods of 10 years, beginning at 25 years of age. The percentageal distribution of the groups within each ten-years' period has been calculated. Yet, in this calculation, the cases which are operated with transvesical prostatectomy have not been included. For these cases exclusively the non-dicoumarin treated group and with their high mean age, 68 years, they would give the age curve a considerable "displacement to the right". As this group lacks correspondence among the dicoumarin treated cases and has a high thrombo-embolic frequency, it will be treated separately.

If one compares the distribution of age within the groups dicoumarin and non-dicoumarin treated patients respectively (fig. 1 a), one finds a good correspondence. The greatest difference within corresponding age groups is 2 %. In the distribution of the material according to sexes the correspondence is somewhat worse. The men show a slight displacement towards the younger ages of the non-dicoumarin treated cases (fig. 1 b). Among the women on the other hand, the younger ones in the dicoumarin treated groups preponderate compared to the non-dicoumarin treated ones (fig. 1 c). The greatest difference between comparable groups is for both men and women 4 % at most. With regard to the relatively small material a greater correspondence in the distribution of age might not be expected.

PERCENTUAL DISTRIBUTION OF AGE WITHIN THE  
RESPECTIVE GROUPS OF DICOUMARIN AND NON-  
DICOUMARIN TREATED MEN AND WOMEN.  
(“PROSTATE” NOT INCLUDED)

FIGURE I a. MEN AND WOMEN.

DICOUMARIN TREATED CASES ———  
NON-DICOUMARIN TREATED CASES - - - -

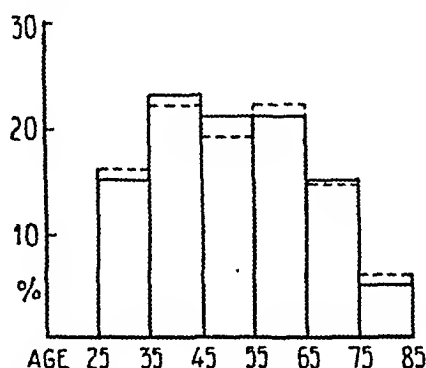


FIGURE I b. MEN.

DICOUMARIN TREATED CASES ———  
NON-DICOUMARIN TREATED CASES - - - -

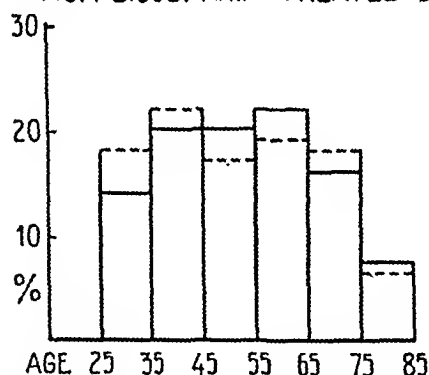


FIGURE I c. WOMEN

DICOUMARIN TREATED CASES ———  
NON-DICOUMARIN TREATED CASES - - - -

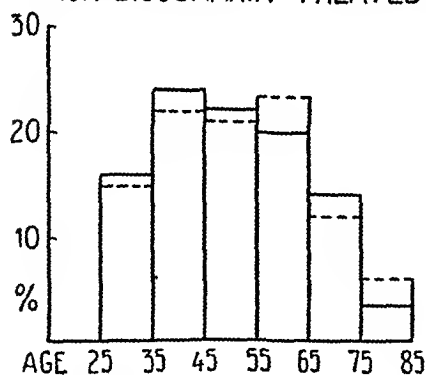


Table 3.

*The number expressed in %.*

Duration of the time in bed in days after operation	Appendicitis		Hernia		Cholelithiasis	
	Dicoumarin treated cases	Non-dicoumarin treated cases	Dicoumarin treated cases	Non-dicoumarin treated cases	Dicoumarin treated cases	Non-dicoumarin treated cases
1	3	3	17	11	0	1
2	39	32	17	17	11	11
3	37	36	25	27	18	21
4	10	15	17	22	23	16
5	4	5	13	13	7	12
6	1	3	5	4	11	11
7	6	6	6	6	27	25

### Duration of the time of stay in bed after operation.

A comparison of the post-operative time of the stay in bed for the dicoumarin and non-dicoumarin treated cases has only been made as to the three greatest operation groups, viz. "appendicitis", "hernia" and "gall" (table 3). Both uncomplicated, suspected, and gangrenous appendicitis and appendicitis complicated with abscess or peritonitis are included in the group "appendicitis". Not fully 9/10 of all the "appendicitis" get up within 4 days after operation, the dicoumarin treated cases to a 3 % greater extent than the non-dicoumarin treated. "Hernia" comprises as well free as incarcerated inguinal hernia, umbilical, gastric and ventral hernia. Within four days after operation an equally great percentage or about 3/4 of both the dicoumarin and the non-dicoumarin treated hernia operated patients have got up. Within the group "cholelithiasis", where all operations of gall bladder and biliary passages are taken together, the dicoumarin treated patients have got up within four days to a 3 % greater extent than the non-dicoumarin treated ones. For both groups, however, it can be established that about 1/2 get up within this time.

As a summing up it might thus be said that the percentual distribution of the duration of the time of stay in bed within those here compared and comparable groups is good.

Table 4.

*Distribution of weight expressed in %.*

Weight in kilos	Appendicitis		Hernia		Cholelithiasis	
	Dicoumarin treated cases	Non- dicoumarin treated cases	Dicoumarin treated cases	Non- dicoumarin treated cases	Dicoumarin treated cases	Non- dicoumarin treated cases
30—39	0	0	0	1	0	0
40—49	2	4	2	2	8	6
50—59	19	18	16	16	15	18
60—69	42	46	28	32	23	23
70—79	23	23	33	30	32	33
80—89	12	6	10	12	19	13
90—99	2	3	11	7	4	6

**Body weight.**

The body weight, as is the case concerning the duration of the time of the stay in bed, has been examined only for patients operated on for appendicitis, hernia and gall (table 4). Within all these groups the two heaviest weight classes taken together are percentually somewhat greater among the dicoumarin treated cases than among the non-dicoumarin treated ones. The differences, however, are rather small. On the whole, the percentual distribution of weight within comparable groups might be considered to correspond well.

**The composition of the material as to operative measures.**

The percentual distribution of various operations within the dicoumarin and non-dicoumarin treated groups appears from table 5. Operations in the groups "kidney etc.", "gall", "ventricle" and "colon and rectum" might be considered as particularly disposed for thrombo-embolic complications. These four groups are as well for the men as for the women among the dicoumarin treated patients 28 % of all the operated cases. In the non-dicoumarin treated cases the corresponding figure is somewhat



Table 5.

*The percentual distribution of the operations within the respective groups.*

Diagnosis	Dicoumarin treated cases		Non-dicoumarin treated cases		
	Men	Women	Men	Women	
Trans- and intrathoracic operations . . . . .	2.7	1.1	4.6	5.3	1.8
Kidney, ureter, bladder . . .	10.1	3.6	8.9	10.1	4.9
Prostate . . . . .			12.2		
Hernia . . . . .	23.2	9.9	14.2	16.2	5.7
Appendicitis . . . . .	19.3	19.5	12.6	14.4	10.0
Gall . . . . .	3.0	15.1	3.9	4.5	18.4
Ventricle . . . . .	8.3	4.4	6.2	7.1	1.9
Colon and rectum . . . . .	7.4	4.9	2.3	2.7	5.1
Mammary tumours . . . . .		20.6			10.6
Bone and joint . . . . .	2.4	1.9	4.4	5.1	6.2
Goitre . . . . .	0.3		2.0	2.2	13.8
Various . . . . .	23.4	19.0	28.6	32.6	21.7
Σ % . . . . .	100.1	100.1	99.9	100.2	100.1

lower for the men, 24 %, and somewhat higher for the women, 30 %. The differences are, however, not greater than, even from this point of view, one ought to be entitled to consider the dicoumarin and non-dicoumarin treated cases as comparable.

As a summing up it may be stated that the difference is slight in the percentual distribution of the here investigated thrombo-embolic disposing factors among the dicoumarin and non-dicoumarin treated cases. Among the men, who have obtained dicoumarin prophylaxis, there is as to age and operations a slight displacement to thrombo-embolic disposition compared to the non-dicoumarin treated ones. For the women this displacement is reverse. The prophylactically treated women should have an insignificantly less thrombo-embolic disposition.

The distribution among dicoumarin and non-dicoumarin treated patients of duration of stay in bed after operation and of body weight within appendicitis, hernia and gall operated groups appears on the whole to correspond.

## The dosage of dicoumarin in prophylactic treatment.

In the prophylactic dicoumarin treatment the dosage indicated by BRUZELIUS (1945) has in the main been followed. The initial dose, given the day after operation, has thus been 0.25—0.125 gm dicoumarin, never greater. The lower dose is reserved for old or debilitated patients, patients with a larger wound or cases where the intestinal passage can be expected to be obstructed longer than normally. Has the prothrombin index decreased only slightly the following day or not at all, a further 0.125 gm dicoumarin is administered. Thus is proceeded until the prothrombin index is below 60. If the prothrombin index curve shows a steep fall, but the index value has not decreased to 60, the patient is given no further dicoumarin tablet that day. The following day's prothrombin value is expected. If this shows no or only a slight decrease, index not below 60, a further 0.125 gm is administered. Falls the prothrombin index below 40 units, water-soluble vitamin K is supplied. If the patient does *not* bleed, 0.5 mg vitamin K per os is given, if the patient can swallow, otherwise subcutaneously. A new prothrombin determination is done after four hours. Has the index value not ceased to decrease, a somewhat larger dose of vitamin K is given, 1—2 some time 5 mg. Is the fall alarming larger doses of 10—20 mg have been administered. We have not found the very large doses of 100—200 mg of vitamin K necessary in prophylactic dicoumarin treatment. They cause great and not desirable displacements in the prothrombin index curve. In cases of bleeding, which can be supposed to be due to the dicoumarin treatment, the patient is given vitamin K in a dose of 20 mg; is the bleeding serious, blood transfusion with "fresh blood" is given besides.

## Complications in the form of bleeding in prophylactic dicoumarin treatment.

In the dicoumarin treated cases in the material presented here, all bleedings have been considered to be due to dicoumarin. No fatal bleeding or any that has been difficult to master has occurred. The men show a somewhat higher disposition to bleedings than the women, both with regard to dicoumarin and non-dicoumarin treated cases (table 6). For all the frequency of bleedings is higher for the dicoumarin treated,  $1.6 \pm 0.47$  %, than for the non-dicoumarin treated patients,  $0.5 \pm 0.21$  %. The differ-

Table 6.

	Complications in the form of bleedings			
	Dicoumarin treated cases		Non-dicoumarin treated cases	
	Number	%	Number	%
Men . . . . .	7	2.1	4	0.7
Women . . . . .	4	1.1	1	0.2
Total	11	1.6	5	0.5

ence,  $1.1 \pm 0.52$  %, is however, not significant, possibly probable ( $\sigma = 2.1$ ).

The figure obtained here of the frequency of bleedings in prophylactic dicoumarin treatment,  $1.6 \pm 0.47$  %, is of the same size as that indicated by BRUZELIUS (1945), 2.28 %.

From the material presented here one will be able to conclude that an increase of the complication of bleeding as well as the fatal risk the patients are exposed to are very small in a carefully followed dicoumarin prophylaxis.

### Thrombo-embolic complications.

The diagnosis thrombosis and embolism respectively.

Not only so-called evident cases have been counted as thromboses but also such, where the patient complains of pains or of feelings of heaviness from the leg and that without any objective discoveries proving the diagnosis thrombosis. Phlebogram has not been done. A sudden setting in of a stitch in the chest has been considered sufficient for settling the diagnosis embolism. The verification of the diagnosis embolism by bloody sputum has not been regarded as necessary, nor have roentgenologically determinable changes. The diagnosis thrombo-embolism in the post-operative course has in this way in all probability been settled oftener than this complication has really occurred. Less probable it appears, on the other hand, that the percentual distribution of erroneous thrombo-embolic diagnoses should be different among the dicoumarin and the non-dicoumarin treated cases. For the former uncertain diagnosis is noted down in 19 %, for the latter in 17 % of the cases.

**Trombo-embolic complications among patients with odd and even journal numbers.**

If the frequency of thrombo-embolisms among the here occurring odd journal numbers is examined and compared to the frequency among the even journal numbers, it will be possible to answer the question, if post-operative dicoumarin treatment at early rising diminishes the number of thrombo-embolisms on an operated material, which thus also comprises the cases, where this prophylaxis has been counter-indicated and has consequently not been given. In other words: if early rising is used as post-operative thrombo-embolic prophylaxis, is it then possible to make a further decrease of the thrombo-embolic frequency by dicoumarin prophylaxis in spite of the fact that dicoumarin is counter-indicated in a number of cases?

Out of 940 cases, who were in principle to get post-operative dicoumarin prophylaxis,  $1/4$  have not got such treatment (table 2). 29 thrombo-embolisms were diagnosed among these 940, which corresponds to  $3.1 \pm 0.57$  %. The control group without dicoumarin prophylaxis comprises 891 cases with  $50 = 5.6 \pm \pm 0.77$  % thrombo-embolisms. The difference is  $2.5 \pm 0.96$  % and thus likely ( $\sigma = 2.6$ ), even though it is not statistically proved. Is the material divided up according to sexes, one finds no difference in the thrombo-embolic frequency among the men in the prophylactically treated group and in the one which has not received dicoumarin (3.9 and 4.5 % respectively). For the women on the other hand, a statistically proved decrease of thrombo-embolic complications in the former group can be established. The difference compared to those who have not received dicoumarin prophylaxis is  $4.4 \pm 1.28$  % ( $\sigma 3.4$ ).

In a material treated with early rising and comprising all operated cases women consequently get a further protection against the thrombo-embolic complication by post-operative dicoumarin prophylaxis. Men on the other hand do not seem to receive any such increased protection through this treatment.

**Thrombo-embolic complications among prophylactically dicoumarin and non-dicoumarin treated patients.**

From earlier exposition it will appear that the dicoumarin and non-dicoumarin treated groups are on the whole homo-



geneously composed and thus comparable. This is only the case, however, provided the "prostate group", *i. e.* those operated with transvesical prostatectomy, are excepted. Among the other 1,061 non-dicoumarin treated patients 52 thrombo-embolisms have occurred or  $4.9 \pm 0.66$  % (table 7). The corresponding figure for the prophylactically dicoumarin treated ones is  $2.3 \pm 0.57$  %. The difference is  $2.6 \pm 0.87$  %. The mean error enters 3.0 times in the difference and this is thus statistically ensured. One also finds that, after all operations except for the intra- and transthoracic ones, the thrombo-embolic complications are more frequent among those who have not received dicoumarin prophylaxis than among the corresponding prophylactically treated cases.

Is the material divided up according to sexes again, one finds no definite decrease for the men of the number of thrombo-embolisms in dicoumarin treatment (3.0 and 3.4 respectively). Not even if the "prostate group", heavily charged with thrombo-embolic complications, is included in the non-dicoumarin treated cases, does the prophylactic treatment in this material give any statistically provable decrease of the number of thrombo-embolisms (difference  $1.9 \pm 1.30$  %). Among the women on the other hand thrombo-embolisms are more frequent among the non-dicoumarin treated patients (6.2 %) than for the dicoumarin treated ones (1.7 %), in spite of the fact that the former group includes all women operated on for goitre. The difference is  $4.5 \pm 1.22$  % ( $\sigma = 3.7$ ) and consequently shows a definite decrease for women of thrombo-embolic complications in post-operative prophylactic dicoumarin treatment.

*Fatal pulmonary embolisms:* In a material, where 98.9 % of the post-operatively deceased are subjected to section, the figure of the number of fatal pulmonary embolisms might be considered to be exact. No fatal pulmonary embolism has occurred among the prophylactically treated cases. On the other hand 7 such deaths have occurred among those who did not get this prophylaxis, in spite of the fact that heparin and dicoumarin treatment were given as therapy in all the cases where there was time for such treatment and the diagnosis thrombo-embolic complication could be settled clinically. The frequency of fatal pulmonary embolisms for all operated non-prophylactically dicoumarin treated cases is  $0.62 \pm 0.23$  % and shows a likely even though not statistically proved difference compared to the dicoumarin

treated ones. If the "prostate group" is excluded, in which 3 fatal embolisms have occurred, the frequency is  $0.38 \pm 0.19$  % among the other non-dicoumarin treated cases. The difference compared to the percentual number of fatal pulmonary embolisms among the dicoumarin treated cases is, calculated in this way, no longer statistically likely but probable.

The figures obtained thus indicate that prophylactic post-operative dicoumarin treatment can diminish the number of fatal pulmonary embolisms.

### Final remarks.

As an answer to the earlier stated problem, the material presented here has given the result that at early rising post-operative dicoumarin prophylaxis does not give any decrease of the number of thrombo-embolic complications for men. For women on the other hand, one obtains a definite decrease of the thrombo-embolic cases, as well if these are calculated on the only dicoumarin treated ones as on the whole group, where prophylactic treatment was to be set in but was counter-indicated or for some other reason was not given in a certain number of cases.

In spite of early rising post-operative dicoumarin prophylaxis should thus be given to women. For men, however, this prophylaxis might be without provable value. Yet the possibility of a decreased number of fatally proceeding pulmonary embolisms should be emphasized.

### Summary.

The object of this investigation has been to try and answer the question if post-operative dicoumarin prophylaxis at early rising gives some further protection against thrombo-embolic complications. All the 1,831 patients, 25 years of age or older, operated on at the Surgical Clinic in Lund during 1946 have been divided up into two groups according to their journal numbers. The odd journal numbers received prophylactic treatment, when such treatment was not counter-indicated or was not given from some other reason, the even journal numbers on the other hand did not get such treatment. The number of the thrombo-embolisms

show for the women but not for the men a statistically proved lower frequency among the odd journal numbers.

The material has also been divided into prophylactically and non-prophylactically treated cases, since the groups thus obtained have turned out to be comparable as to the distribution of the age of the patients, operative measures, post-operative duration of stay in bed and the weight of the patients. The two latter factors, however, have been examined only in patients operated on for appendicitis, hernia and gall. The patients operated on with transvesical prostatectomy have not been included, as, owing to their high age and the thrombo-embolic frequency, they charge the non-dicoumarin treated group one-sidedly. Also in this distribution of the material a statistically proved decrease of the thrombo-embolic frequency in prophylactic dicoumarin treatment is found with regard to the women but not with regard to the men.

It has moreover been possible to prove that in post-operative dicoumarin prophylaxis the risk of bleedings is very small and that the fatally progressing pulmonary embolisms can possibly diminish in number.

The conclusion of the investigation is that in early rising women obtain a further protection against thrombo-embolic complications by post-operative dicoumarin prophylaxis and that consequently they should obtain such treatment. For men on the other hand this prophylaxis seems to be without provable value. A possible decrease of fatally progressing pulmonary embolisms should, however, be emphasized.

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## Appendicitis Material at the Karolinska Sjukhuset 1940—1944.

By

TORE EKSTRÖM.

In the Surgical Department at Karolinska Sjukhuset a review is regularly made, usually each month, of the material concerning some certain disease. The following paper is a part of this work. Some of the points of view and experiences which seemed worthy of note are to be pointed out. This especially refers to the mortality in appendicitis material when chemotherapy, thrombosis-prophylaxis, and fluid-balance control are employed.

This paper includes 2,349 cases, of which 1,113 came from the Surgical Clinic and 1,236 from the Military Department. These are divided into the following groups: I. Acute appendicitis, II. Appendiceal abscess, III. Appendectomy on the diagnosis of acute appendicitis in which the appendix proved to be not inflamed, and IV. Chronic appendicitis, so called. Since the military cases represent a selected group as to age and sex they have not been combined with the clinic material throughout. The number of cases according to sex is seen in Table 1.

Table 1.

	I Acute app.		II App. abscess		III Not-inflamed app.		IV Chronic app.	
	Male	Fem.	Male	Fem.	Male	Fem.	Male	Fem.
Clinic .....	331	375 (53 %)	11	11 (50 %)	62	131 (68 %)	36	156 (81 %)
Military ..	882	16	11		254	2	67	4
Total	1,604		33		449		263	

The mortality in the material being studied was exceptionally low. It amounted to only  $0.38 \% \pm 0.01 \%$  (9 deaths) for the whole material with 7 deaths in group I and 1 death in each of groups II and III. The last mentioned death was in no way related to the operation. Actually it can be said that appendectomy itself in this material did not result in a single death.

## I. Acute Appendicitis.

The distribution of the Clinic cases according to age corresponds with earlier series (PERMAN 1928, KRAFT 1929, BRUUSGAARD 1930, and NETTELBLAD 1943, among others). It must be pointed out that children are only exceptionally admitted to Karolinska Sjukhuset and therefore comparison with series which also include childhood appendicitis to the full extent is not possible. The frequency however, as in the other series, is greatest between 15 and 30 years.

Concerning peritonitis, this complication is relatively more common in the older age groups. Comparing the cases of acute appendicitis under 45 and over 45 years, a statistically significant difference in frequency of peritonitis can be shown, indicating a greater frequency for the older age groups ( $\chi^2 = 3.49$ ,  $n = 1$ ).

Table 2 shows the 706 Clinic cases according to age groups.

Table 2.

	0—14 yrs.	15—29 yrs.	30—44 yrs.	> 45 yrs.
Uncomplicated appendicitis .....	7 %	59 %	25 %	9 %
Cases of peritonitis .....	9 %	42 %	16 %	33 %
Total	8 %	57 %	24 %	11 %

According to more recent statistics women have somewhat predominated (E. PERMAN 1928, G. NYSTRÖM 1932). Older statistics often showed a male predominance (E. S. PERMAN, 1904: Sabbatsberg hospital material 1899—1904, and K. H. GIERTZ, 1909: Upsala hospital material 1899—1907). In comparison with the later series, females seem to predominate somewhat and comprise  $53 \% \pm 1.9 \%$  of the Clinic material.

Grouping of acute appendicitis has been done with regard to the grade of inflammatory change in the appendix and the extent of the infection beyond the appendix. The catarrhal cases were for the most part examined microscopically. In that group

females predominate (see Table 3), which agrees with what PERMAN (1928) found by comparing "light" with "severe" cases. The cases of gangrenous appendicitis include all degrees of gangrenous spread. Together with the phlegmonous types this group makes up a full  $\frac{3}{4}$  of the entire material. The small group of "perforated gangrene" consists of sealed perforations or small perforations having just occurred and without peri-appendiceal reaction. Purulent material in the abdomen or a positive culture have been demanded for the diagnosis of "peritonitis". Cases with more or less walled off abscesses or peri-appendiceal inflammation confined to the right lower part of the abdomen have been denoted as "circumscribed peritonitis". The borderline between the latter cases and those denoted as "appendiceal abscess" is not clear, but when the operation was performed on the suspicion of acute appendicitis and no appendiceal abscess could be determined before surgery, then it has seemed appropriate to include them in this category. The designation "diffuse peritonitis" has been reserved for cases with purulent or bacterial material diffuse in the peritoneal cavity. The percentage of perforations (7.4 %) is strikingly low. The corresponding figures for Örebro (BOHMANSSON and NORUP, 1941) was 16 %, but that material did not include catarrhal appendicitis. Table 3 shows the division of the cases according to different groups.

Table 3.

	Clinic		Military Number	% by groups
	No.	% men		
1. Catarrhal .....	87	22	117	12.7
2. Phlegmonous .....	223	50	227	78.8
3. Gangrenous .....	329		485	
4. Gangrene + circumscri. perit. ....	7	56	8	8.5
5. Gangrene + diffuse peritonit. ....	2		1	
6. Perforat. gangr. ....	4		9	
7. " " + circum. perit. ....	28		33	7.4
8. " " + diffuse perit. ..	26		18	

1—3 = "light" cases

4—8 = "severe" cases

Earlier difficulty of the same character as that before surgery occurred in at least  $\frac{1}{5}$  of the cases according to the records. This is of course a minimum figure, since this point is not recorded in all cases in which it occurred. Possibly it is especially in the

"severe" cases that one neglects to ask about this point, and therefore one cannot draw any absolute conclusions from a comparison between the different grades of appendicitis. It is, however, striking how often one finds a history of earlier similar attacks of pain in catarrhal appendicitis. Similar difficulty has been determined in 29 % of the latter cases, 22 % of cases with phlegmonous and gangrenous appendicitis, and 20 % in the entire group of "severe" cases.

As a background to the low mortality in this material it is necessary to discuss the duration of the illness. Since the material comes from a large urban population it is natural that the history is shorter even in the "severe" cases. Of the 136 "severe" cases (with spread of infection beyond the appendix) 55 had been sick only about 1 day or less and only 19 more than 3 days. It has been observed that older persons get peritonitis relatively early. Here we have not found any considerable number of the older age group with especially short histories among the peritonitis cases. Of the 22 Clinic cases of peritonitis with a history of 1 day or less 11 were under 30 years old.

Table 4 shows the relations of the temperature, white blood count (W. B. C.), and sedimentation rate (S. R.) for the Clinic cases.

Table 4.

	Catarrhal	Phlegmonous	Gangrenous	"Severe" Cases
Temp. ....				
< 38° .....	78 %	61 %	52 %	21 %
> 39° .....	2.3 %	3.6 %	6.4 %	42 %
W. B. C.				
< 10,000 .....	60 %	25 %	15 %	12 %
> 20,000 .....		10 %		17 %
S. R.				
< 10 .....		53 %		32 %

The temperature was in the majority of cases between 37.5° and 38.5° and higher temperatures than 39° were very rare in the "light" cases. Only in the "severe" cases was it common to find temperatures of more than 39°. In  $\frac{1}{5}$  of the "severe" cases, however, the temperature was less than 38° and among these were found 7 cases with diffuse peritonitis. Nor can the W. B. C. be assigned any certain significance in the individual case. In the cases of perforated appendicitis with peritonitis the W. B. C. was under 10,000 in 8 of 51 cases and 3 of 26 cases with diffuse peritonitis had a count of under 5,000. In evaluation of leucocytosis and the S. R. the duration of the illness is of the greatest significance as was shown by HELLSTRÖM (1943).

Post-operative complications occurred very seldom in the "light" cases of appendicitis and principally involved the "severe" cases. Among the more serious complications pneumonia was most common. In appendicitis without peri-appendiceal spread this complication was dominant and in one such case resulted in death. In appendicitis with peritonitis post-operative ileus which compelled re-laparotomy was the most common complication except for abscess in the pouch of Douglas. Of the 9 cases which were re-operated on this basis there was a question of mechanical ileus in 6 cases and paralytic ileus in 3 cases. They were operated from the 4th—13th day after appendectomy. In the "severe" cases there is also considerable risk of thrombus-embolus phenomena and in one such case death resulted. Table 5 shows the number of serious complications which were encountered in this material.

Table 5.

Complications	"Light" Cases 1,468 cases	"Severe" Cases 136 cases	Total 1,604
Pneumonia .....	37 (2.5 %)	6 (4 %)	2.7 %
Thrombus-embolus .....	10 (0.7 %)	6 (4 %)	1.9 %
Ileus .....	1	9 (7 %)	0.6 %
Abscess in pouch of Douglas .....	5	11 (8 %)	1.0 %
Subphrenic abscess .....	1 (0.1 %)	2 (1.5 %)	0.2 %
Other intra-abdom. abscesses .....	1	4 (3 %)	0.3 %
Bowel fistulae .....	2	1	0.2 %
Sepsis .....	—	2	0.1 %

In cases of circumscribed peritonitis, primary suture was done in 15 of 76 cases. These consisted of cases with small abscesses which most often were removed at operation or of cases without true abscess formation. In the 47 cases of diffuse peritonitis primary suture was carried out in only 17 cases. We have in this situation followed the rules which appear in BAUER's treatise (1933) and have done a primary suture in such a case when no localized center of infection is left. As for post-operative treatment, fluid balance, and serum protein were checked and in most cases chemotherapy was started at once and also prophylaxis — or early therapy — to combat post-operative ileus. "Peritonitis serum" was not given in any case.

The mortality is extraordinarily low, which perhaps ought to be attributed primarily to the short history even in the "severe" cases. The post-operative treatment, in the form of chemotherapy and early ambulation, can also possibly be a contributing factor. Table 6 shows the mortality in this material and Table 7 shows some other mortality figures.

Table 6.

Mortality	Clinic	Military	Total
Non-perforated app... 2:648 = 0.31 %	1:838 = 0.12 %	0.20 % $\pm$ 0.12 %	
Perforated appendicit. 2:58 = 3.4 %	2:60 = 3.3 %	3.4 % $\pm$ 1.7 %	
Total 4:706 = 0.57 %	3:898 = 0.33 %	0.44 % $\pm$ 0.16 %	
♂: 0.9 % $\pm$ 0.52 %			
♀: 0.3 % $\pm$ 0.27 %			

Table 7.

	% Perf.	Mortality
BOHMANSSON & NORUP (1941) (Catarrhal app. not included) (3,797 cases from yrs. 1929—40) .....	16	3.9 %
BURKE & KOHN (1941) (22,000 cases combined Am. statistics) .....	20.96	4.66 %
HOLST (1927) (1,823 cases) .....	—	3.1 %
HUSFELDT & GILG (1943) (221 cases from yrs. 1040—42 treated with sulfonamides) .	10.5	3.1 %
NYSTRÖM (1932) (3,157 cases from yrs. 1922—30) .....	—	2.4 %
WARNHUIS (1926) (Combined American statistics of 5,736 cases) .....	—	4.2 %

Any direct comparison between the mortality figures in different statistics cannot be made, of course, since the material is essentially different, which is perhaps most apparent in the variable figures for the perforation percentage. For the relatively few cases of perforated appendix which are here presented the mortality was surprisingly low.

## II. Appendiceal Abscess.

To this group were assigned the 33 cases in which one was able to make the diagnosis of appendiceal abscess preoperatively. The histories were longer than in the cases of acute appendicitis, varying between 3 days and 1 month, in most cases between 4 and 10 days. As a rule one was able to palpate a tender resistance in the right lower abdominal quadrant or by rectum. The division according to age corresponds to that of the peritonitis cases with acute appendicitis. Previous attacks of pain were recorded in  $\frac{1}{3}$  of the cases. Temperature over  $38^{\circ}$  and W. B. C. over 10,000 were recorded in  $\frac{3}{4}$  of the cases. The S. R. was as a rule significantly increased and in only 2 cases was it under 20 mm. Operation was performed in 19 cases, of which 17 cases were only drained and in 2 cases appendectomy was done in addition. Surgery was not performed when the abscess was of small size, well walled off

and caused no alarming symptoms. No effort was made to perform appendectomy at the time of drainage. One death occurred on the basis of cardiac insufficiency in the case of a 73-year-old patient. Otherwise, no serious complications were encountered. As a rule appendectomy in a later séance was advised, and in such cases one found exactly the same macro- and microscopic picture as in so called chronic appendicitis. Of the 12 secondary operations carried out at this hospital, there was found in only 2 cases a picture of active chronic inflammation and in the remaining cases the picture was that of less marked chronic changes (sclerosis of the submucosa, and atrophy of the mucous membrane or obliteration).

### III. Appendectomies on the Diagnosis of Acute Appendicitis in which the Appendix Proved to be not Inflamed.

All together 449 cases were operated on with a diagnosis of acute appendicitis in which appendicitis was not present. In operations for acute appendicitis, therefore, 22 % showed no inflammation of the appendix. Subtracting the cases in which laparotomy on the basis of some other disease nevertheless was found to be necessary there remain about 20 % which were needlessly operated upon. Among the Clinic cases females comprised 68 %. From Table 8 it is apparent that the most common wrong diagnosis consists of bowel infections of different sorts, which comprise more than half of the cases if one includes mesenteric lymphadenitis. Fecal stone or oxyuriasis in the appendix

Table 8.

#### *Appendectomies on mistaken diagnosis.*

Final diagnoses	No. of cases	%
Acute mesenteric lymphadenitis .....	153	35.6
Tuberculous mesent. lymphadenitis .....	7	
Acute enterocolitis .....	70	20.7
Terminal ileitis .....	14	
Sigmoidal diverticulitis .....	3	
Meckel's diverticulitis .....	6	
Fecal stone in appendix .....	34	10.5
Oxyuriasis in appendix .....	9	
Carcinoid in appendix .....	3	
Mucocele in appendix .....	1	
Acute salpingitis .....	12	4.9
Ruptured corpus luteum .....	10	
Other diseases .....	24	5.3
Uncertain diagnoses .....	103	23.0

occurred in nearly 10 % as the only finding and together with other pathological findings in another full 10 %. For the Clinic cases, gynecological diseases comprised 11 %. In nearly  $\frac{1}{4}$  of the cases one was able to find no certain explanation of the symptoms.

The age grouping of these cases compared with acute appendicitis shows the younger age groups to be more numerously represented, which indeed is to be expected since the indications for operation for younger patients are broader in an abdominal case in which appendicitis is suspected. Among the Clinic cases, therefore, 13 % are under 15 years, 67 % between 15 and 30 years, and only 20 % over 30 years. The female preponderance is explained only to a small extent by the gynecological diseases and ought chiefly to be connected with the fact that bowel disturbances are more common among women. Only one death, on a basis of sepsis, occurred and in this case the operation cannot be blamed for the unfortunate result. The post-operative complications were similar to the "light" cases of appendicitis.

#### IV. Chronic Appendicitis, so called.

In the group "chronic appendicitis" were collected cases which for a long time or with repeated attacks had appendicitis like difficulties and therefore were operated on the basis of a suspected chronic appendicitis. The difficulty as a rule had existed from months up to several years.

In this group 263 cases were operated. The percentage of so called chronic appendicitis to acute appendicitis is 16.4 %. For females alone that percentage is 40.9 % and for men 8.6 %. Among the Clinic cases women comprise  $\frac{4}{5}$  of the so called chronic appendicitis. Temperature, S. R., and W. B. C. were as a rule normal. Only in  $\frac{1}{8}$  of the cases was the temperature  $> 38^{\circ}$  and  $\frac{1}{5}$  had leucocytosis ( $> 10,000$ ) while the S. R. was increased in  $\frac{1}{3}$  of the cases.

From Table 9 it is apparent what the findings were on operation, microscopic examination of the appendix or continued observation of the case.

As "active chronic inflammation" were designated those cases in which on microscopic examination unequivocal signs thereof were found (round cell infiltration in the submucosa or muscularis and often in addition eosinophils, sclerosis of the submucosa,



atrophy of the mucous membrane or obliteration). As is seen in Table 9 such findings are relatively rare. By comparing the cases with active chronic inflammation and the others, there is obtained a very probable statistical difference as regards the frequency of females for the Clinic cases (24 cases), which suggests that the female preponderance is not so large for cases with "active chronic inflammation" ( $\chi^2 = 6.34$ ;  $n = 1$ ;  $0.01 < P < 0.02$ ).

Table 9.

*Appendectomy for so called Chronic Appendicitis.*

Findings	No. of cases	%
Active chronic inflammation .....	31	80
Slight chronic changes .....	117	
Acute and chronic changes .....	23	
Pseudomyxomatous appendicitis .....	2	
Carcinoid of appendix .....	1	
Fecal stone in appendix .....	21	10
Oxyuriasis in appendix .....	15	
Mesenteric lymphadenitis .....	24	
Terminal ileitis .....	3	
Chronic salpingitis .....	10	
Ovarian cyst .....	2	4.6
Uncertain diagnoses .....	14	5.4

"Slight chronic changes" in the appendix comprises the largest group and includes such cases in which one found definite pathologic changes in the form of adhesions about the appendix, scars, strictures or kinking, or on microscopic examination sclerosis of the submucosa, atrophy of the mucous membrane, obliteration of the lumen, etc. without, however, the pathological-anatomical appearance to indicate the diagnosis of active chronic appendicitis. These are probably residuals after an acute or chronic appendicitis and the changes ought to permit a satisfactory explanation of the functional disturbance with altered peristalsis. In over 20 % of these cases there is found in the operative note a record of fecal stone. In "appendicitis with acute and chronic changes" one found on microscopic examination both chronic and acute inflammation or on operation found an acute appendicitis with the appendix surrounded by old adhesions or incorporated in scar tissue. These cases have been included in this group with regard to their history and indications for operation. The pathological significance of a fecal stone is not quite clear, but is probably an expression of deficient power of evacuation.

For the purpose of getting an understanding of the results of operation, questionnaires were sent out to cases at least 1½ years post-operative and in the great majority of these cases the interval was more than 2 years after operation. Since it proved difficult to determine the abdominal difficulty in those cases not entirely symptom-free, the answers were divided into only 3 categories: 1) Completely free from all abdominal symptoms (= Well), 2) Clearly improved after operation but not absolutely symptom-free (= Imp.) and 3) Unimproved (= Unimp.). Of 263 inquiries, 225 answers were received and of these 187 are well (83 %). Table 10 shows the results according to the different pathological findings.

Table 10.

Pathological findings	Well	Imp.	Unimp.
Active chronic inflammation .....	28 (93 %)	1	1
Slight chronic changes .....	87 (83 %)	8	10
Acute and chronic changes .....	18	—	—
Tumor formation in appendix .....	2} (100 %)	—	—
Fecal stone or oxyuriasis .....	21 (75 %)	3	4
Normal appendix .....	31 (74 %)	5	6
Total	187 (83 %)	17	21

The best results were obtained with active chronic inflammation in the appendix and with concurrent acute inflammation and not quite such good results with doubtful or no appendiceal changes. If one compares the cases with active chronic and the cases with both acute and chronic inflammation with the cases of fecal stone, oxyuriasis, and normal appendix a significant difference is obtained between the well and unimproved cases. ( $\chi^2 = 7.93$ ;  $n = 1$ ;  $P < 0.01$ ). It might appear quite surprising that even in the latter cases several became symptom-free. This can partly be explained by the fact that at operation in some cases surgical interference was carried out for some other disease (ovarian cyst, chronic salpingitis) but must as a rule be dependent upon the gradual improvement of a protracted bowel infection.

By comparison of the results of treatment for males and females it is found that the results were apparently somewhat more favourable for men, which should be compared with the earlier series (RÖDÉN 1941, POPPE 1935). No significant statistical difference however occurs in this material. Table 11 shows the results for men and women.

Table 11.

	Well	Imp.	Unimp.
Men .....	75 (87 %)	4	7
Women .....	112 (80 %)	13	14

For the purpose of providing a survey of the rather variable histories the material has been divided into 5 groups.

*Group 1:* Corresponds most nearly to what appears to be a typical history for chronic appendicitis: aching pain in the right lower abdominal quadrant with periods of more pronounced discomfort and often increased discomfort with motion. Sometimes radiating pains down to the right leg or out in the back on the right side.

*Group 2:* Recurring attacks of pain in the right lower abdominal quadrant of some days duration and with completely symptom-free intervals.

*Group 3:* In this group the bowel symptoms are outstanding. Diarrhea attacks or longer periods of diarrhea, sometimes alternating with constipation. Aching or intermittent pain down toward the right in the abdomen.

*Group 4:* Recurring attacks of pain over McBurney's point with a new attack before admission, which is classified with acute recurring appendicitis or protracted, aching pain down toward the right in the abdomen with increased intensity before admission and therefore of the type chronic appendicitis with acute exacerbation. Operation was as a rule undertaken immediately after admission.

*Group 5:* More atypical and indefinite history with recurrent brief abdominal griping, pricking or stabbing, or a feeling of pressure or tightness in the right lower abdominal quadrant and often with shorter histories. Often the operation was done on the patient's request. Table 12 shows the division of the cases according to the different history groups and the final results of operation.

Table 12.

Group	No. cases	%	Well	Imp.	Unimp.
Group 1 .....	62	24 %	53 (93 %)	—	4
» 2 .....	56	21 %	40 (82 %)	3	6
» 3 .....	18	7 %	14 (82 %)	2	1
» 4 .....	86	32 %	58 (85 %)	6	4
» 5 .....	41	16 %	22 (65 %)	6	6 (18 %)
Groups 1—4 .....	222	84 %	165 (86 %)	11	15 (8 %)

As is apparent from the table the results are best in group 1 with a typical history and least good in group 5 with a less typical history. By comparing groups 1—4 of rather typical history with group 5 of atypical history one gets a definitely better result in the former case ( $\chi^2 = 9.62$ ;  $n = 1$ ;  $P < 0.01$ ).

Since pathological changes in the appendiceal wall must be considered to have motivated the appendectomy it will be of interest to see how often one found similar changes within the different history groups.

With the more typical histories (Group 1—4, Table 13) one found in  $\frac{3}{4}$  of the cases such pathological changes that operation must have seemed indicated, while in the less typical histories these changes were present in the appendix in only a good  $\frac{1}{3}$  of the cases.

Table 13.

Groups	Changes in append. wall	Fecal stone or oxyuriasis	Normal appendix
Group 1 .....	79 %	5 %	16 %
» 2 .....	70 %	16 %	14 %
» 3 .....	83 %	11 %	6 %
» 4 .....	72 %	10 %	18 %
» 5 .....	37 %	32 %	32 %
	74 %	10 %	15 %

The post-operative complications were rather insignificant and here were limited to 4 cases of pneumonia.

### Summary.

1) The material, which includes 2,349 cases from Karolinska Sjukhuset made up of 1,113 from the Surgical Clinic and 1,236 from the Military Department has been divided into acute appendicitis, appendiceal abscess, appendectomy on the diagnosis of acute appendicitis in which the appendix proved to be not inflamed, and so called chronic appendicitis. The mortality for the whole material amounts to  $0.38 \% \pm 0.01 \%$ .

2) 1,604 cases of acute appendicitis were operated upon. The percentage of perforations (7.4) is unusually low, which is related to the fact that the material represents a large urban population with consistently short histories. The temperature, S. R., and W. B. C. were shown to be of secondary importance in the diagnosis of an acute appendicitis. The mortality for acute appendicitis in this material is remarkably low and is  $0.44 \% \pm 0.16 \%$ . For non

perforated appendicitis the figure is  $0.20 \% \pm 0.12 \%$  and for perforated appendicitis  $3.4 \% \pm 1.7 \%$ . The low mortality is displayed against the background of short histories. The post-operative therapy, and in that regard especially ehemo-therapy ought to have contributed to the low mortality.

3) 33 cases of appendiceal abseess were treated, of which 17 were only drained and 2 had appendectomies as well. If possible the abscesses were treated conservatively and appendectomy advised at a later séance. One death on the basis of cardiac insufficiency in a 73-year-old patient occurred.

4) 449 cases of not inflamed appendix were operated on the diagnosis of acute appendicitis. The most common cause of the mistaken diagnosis was bowel infection of different sorts. In the Clinic material females are in a significant majority (68 %), which possibly is caused by intestinal disturbances being more common among women. One death was encountered in this group, but was not related to the operation itself.

5) 263 cases with chronic appendicitis were operated. Females comprised  $\frac{4}{5}$  in the Clinic cases. In 20 % the appendix was normal. Follow-up studies showed the final result to be very good in that  $\frac{4}{5}$  were absolutely symptom-free. The best results were obtained in the cases with active chronic inflammation in the appendix and in cases with a typical history. No death occurred among those operated upon.

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## Über die klinische Bedeutung der Untersuchung der supraklavikulären Lymphknoten beim Krebs.

Von

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Dass das Karzinom bei seiner Ausbreitung mit besonderer Vorliebe die Lymphbahnen bevorzugt, ist eine bekante Tatsache. Dabei sieht man nicht selten, dass es in den Lymphknoten sogar früher in Erscheinung treten kann, als der primäre Tumor im inneren des Körpers.

Man sieht auch, dass die Form des Karzinoms die man in den betreffenden Lymphknoten findet, oft ein Hinweis auf den Ort geben kann, wo man die primäre Geschwulst zu suchen hat, und nicht selten kann man beobachten, dass der Charakter des primären Geschwulstes in den Metastasen in noch reinerer Form zum Vorschein kommt.

Seitdem VIRCHOW 1848 Magenkarzinommetastasen in der linken Supraklavikulargrube beschrieben und darauf aufmerksam gemacht hat, dass sie schon frühzeitig auftreten können, ist die supraklavikuläre Metastase, auch Virchowsche Drüse genannt, als Fernsymptom und ziemlich oft als Frühsymptom eines Karzinoms des Unterleibes zur Untersuchung gezogen.

1889 konnte TROISIER durch seine zahlreichen Beobachtungen bestätigen, dass die sekundäre Affektion der Halslymphknoten bei Karzinom eines jeden Organs der Bauchhöhle eintreten kann. Dies ist von zahlreichen Klinikern bestätigt worden.

Nach älteren Angaben soll die Virchow'sche Drüse in fast 25 %

aller Magenkarzinomfälle vorkommen (HECHLER). Einige Autoren geben an, dass der Prozentsatz einer Vergrösserung der Halslymphdrüsen bei Karzinom in der oberen Hälfte der Bauchhöhle noch viel grösser sei und messen deshalb diesem Symptom besonders grosse praktische Bedeutung bei.

TARCHETTI hat in seinen Betrachtungen bei 38 Fällen von Magen-, Duodenum-, Leber- und Pankreaskarzinom hervorgehoben, dass der periphere Drüsenapparat in 57.9 % aller Fälle betroffen war. In 9 Fällen = 23.6 % waren die Leistendrüsen geschwollen, in 17 Fällen = 44.7 % fand er die Halslymphdrüsen geschwollen und in 7 dieser Fälle = 18.4 % waren die supraklavikulären Knoten betroffen.

Dagegen wird von seiten einiger Chirurgen der Wert dieses Symptoms bezweifelt, weil es erst dann auftreten soll, wenn die Chirurgen nicht mehr helfen können. Der Nachweis dieser Metastasen wird auch als ein fatales Symptom gewertet, da die Infiltration der Drüsen der linken Supraklavikulargrube retrograd von dem hier in den Angulus venosus mündenden Ductus thoracicus vielleicht auch durch Verbindungen der supraklavikulären — mit den sternalen — und mediastinalen Drüsen erfolgt (FAYR-HOHLBAUM) so soll es der Ausdruck eines Befallenseins der gesamten Lymphbahnen durch den Einbruch der Tumormassen sein.

Es wird auch darauf verwiesen, dass es Fälle von sicheren Karzinomen z. B. Magenkarzinom gibt, bei denen die supraklavikulären Lymphknoten Schwellung, meist links, zeigen und hart, nicht druckempfindlich, oberflächlich und gut verschieblich sind, und als Virchowsche Drüsen imponieren — wo aber die histologische Untersuchung oft genug nur das Bild desquamierter, gewucherter und vergrösserter Sinusendothelien erweist, oder ihre tuberkulöse Natur zum Vorschein bringt.

Most meint, dass man auch in solchen Fällen, vielleicht an Serienschnitten Karzinomzellen nachweisen könnte, denn gar nicht selten findet sich in metastatisch erkrankten Lymphknoten eine Kombination von Karzinom und Tuberkulose (KRISCHE).

Nach Beobachtungen von WERTHEMANN verlaufen die Magenkarzinome im hohen Alter relativ gutartig, in einem grossen Teil der Fälle können sie aber sowohl klinisch durchaus rasch und bösartig als mit weitgehender Metastasierung einhergehen, wodurch sie sich in keiner Weise von den Magenkrebsen jüngerer Individuen unterscheiden. Auch in dieser Prosektur sahen wir

nicht selten solche Fälle, sowohl in den supraklavikulären als in anderen Lymphknoten.

POSCHARISSKY ist der Ansicht, dass der Reifegrad des Karzinoms sich umgekehrt proportional zur Metastasenbildung verhält und dass das Karzinom bei Personen höheren Alters, im Gegensatz zu jüngeren Menschen, die Neigung lokal zu bleiben und keine Metastasen zu bilden zeigt.

Im allgemeinen bilden die Lymphknotenmetastasen oft mächtige Tumoren, die am Umfang das primäre Gewächs bisweilen sehr beträchtlich übertreffen, namentlich bei den Karzinomen des Oesophagus und Magens (STERNBERG).

Neuere Beobachtungen haben doch erwiesen, dass auch bei Karzinomen anderer Organe der Bauchhöhle, bei Genitalkarzinomen und Karzinomen der Brusthöhle die Metastasen in den Supraklavikularknoten und nicht nur links, sondern auch rechts zu finden sind und diagnostisch verwertet werden (ERNST, KONJETZNY, LUNDSGAARD, MASUICHI, TAKINO, LEDDY-DESJARDINS, VIACAVA-PACK).

Die diagnostische Bedeutung der supraklavikulären Drüsenmetastase wird doch besonderes der linken Seite anerkannt. Es ist indessen nicht zu verneinen, dass Meinungsverschiedenheiten bezüglich der Häufigkeit seines Vorkommens und seiner klinisch-diagnostischen Bedeutung als Frühsymptom bestehen.

Ausgehend von diesem Standpunkt, habe ich die Frequenz der Virchow'schen Drüse bei Karzinomen verschiedener Organe an einem verhältnismässig grossen und regelmässig registrierten Stockholmer Sektionsmaterial (Krankenhaus St. Erik) aus den Jahren 1937 bis 1945 (inkl.) untersucht.

Zu diesem Zeitraum kamen 914 verschiedenorts lokalisierten Karzinomfälle vor, unter denen 129 Mal linksseitige Supraklavikularmetastasen bezeichnet worden waren, was 14.11 % der Fälle entspricht; dabei sind zu der Gesamtzahl der Karzinomfälle auch ganz kleine beginnende Karzinome mitgerechnet worden. Nach der Lokalisation des primären Karzinoms verteilen sich die Supraklavikularmetastasen folgendermassen (abgerundete Zahlen): Mamma 21 %, Prostata 18 %, Leber und Gallenwege 17 %, Lungen 16 %, Magen 14 %, Ovarien und Uterus 13 %, Pankreas 12 %, Darm 8 % und Speiseröhre 7 % (Tab. 1).

Da bei diesen Karzinomfällen die mikroskopische Untersuchung der Supraklavikulardrüsen nur in zweifelhaften Fällen ausgeführt worden ist, dient als Grundlage bei solchen Fällen die



Tab. 1.

Lokalisation	Karz. Fälle	Suprakl. Metast.	%	Mikrosk. kontr. suprakl. Metast.	%
Mammæ .....	57	12	21.05	5	8.77
Prostata .....	61	11	18.01	6	9.84
Hepar. ves. fell...	110	19	17.27	11	10.0
Pulmones .....	127	20	15.75	12	9.45
Ventriculus .....	294	41	13.94	17	5.78
Uterus, Ovarium..	48	6	12.71	5	10.42
Pancreas .....	66	8	12.12	3	4.54
Intestinum .....	122	10	8.19	4	3.28
Oesophagus .....	29	2	6.89	1	3.45
	914	129	14.11	64	7.0

durch makroskopische Untersuchung festgesetzte Diagnose. Diejenigen Fälle sind auch in der vorstehenden Tabelle gesondert angeführt.

Das Vorkommen der Supraklavikularmetastasen bei Frauen und Männern war variierend, es konnte aber kein besonderer Unterschied festgestellt werden.

Nach KONJETZNY befällt die Erkrankung einer oder mehrere Supraklavikularlymphknoten, die gewöhnlich Haselnussgrösse nicht überschreiten. Es sind aber in der Literatur auch grössere Metastasen geschildert worden (LEYDHECKER walnussgross, HENOCH, KONJETZNY taubeneigross, LÉPINE — bei einem Fall von Pyloruskarzinom — ein hühnereigrosses Konglomerat und LEDDY-DESJARDINS einen  $3 \times 4$  cm grossen).

Die Supraklavikularmetastasen waren in den von mir durchgesehenen Fällen 70 Mal erbsen- bis bohnergross, 53 Mal haselnuss- resp. walnussgross, 2 Mal pflaumengross, 2 Mal hühnereigross. In zwei Fällen waren sie mandarinen- bis apfelsinengross.

Die Bedeutung des Ductus thoracicus als Vermittler für die Verbreitung des Karzinoms ist allgemein anerkannt. Da die in den Truncus jugularis vereinigten ausführenden Gefässe der Supraklavikulardrüsen in der Regel in den Ductus thoracicus in der Nähe der Vereinigungsstelle derselben mit Vena jugularis interna einmünden, so braucht die Verschleppung der Karzinomzellen aus allen Organen, die dem Quellgebiet des Ductus anhören, durch den nicht ungewöhnlichen retrograden Transport in die Supraklavikularlymphknoten gar nicht sehr selten zu sein. Dabei ist es sehr gut denkbar, dass die Druckschwankungen in der Brusthöhle

und in den grossen Gefässen und im Ductus dafür begünstigende Bedingungen darbieten, dass also z. B. bei starker Expiration die mit Karzinomzellen beladene Lymphe des Ductus thoracicus in die abführenden Gefässe der Supraklavikulardrüsen zurückfliessen kann (LESNÈS, VIERTH, ERNST).

Für die Metastasierung in die rechtsseitigen Supraklavikular-knoten sind nach HOSCH zwei Möglichkeiten angegeben: Entweder Metastase auf dem Umwege der linksseitigen Lymphknoten ohne dass diese, wenigstens anfangs, selbst Metastasen zeigen, oder der Ductus thoracicus mündet in die Venen der rechten Körperhälfte ein.

In meinem ganzen Material von Metastasen fanden sich nur drei Fälle mit beiderseitig befallenen supraklavikulären Lymphknoten und zwar 1 Magenkarzinomfall (Pat. 37 Jahre alt), 1 Lungenkarzinom (Pat. 42 Jahre alt) und 1 Leberkarzinom (Pat. 49 Jahre alt).

Einige Autoren glauben behaupten zu können dass die Metastasen in die rechtsseitigen Supraklavikularknoten bei Karzinomen der Brusthöhlenorgane, insbesondere der Lungen entstehen.

So hat TAKINO mehrere Fälle von Lungentumor beobachtet, in denen der Tumor im linken Oberlappen und zwar im linken Hilus lag und dessen Metastasen wenigstens anfangs nur in den rechten supraklavikulären Lymphknoten zu finden waren. Er hat auch Fälle beschrieben, wo der Tumor seinen Sitz in dem rechten Hilus hatte, die Metastasen aber zuerst die linken supraklavikulären Drüsen befallen hatten. Auf Grund seiner Beobachtungen bei 15 klinischen Fällen von Lungentumoren aus der Periode 1932—1934, hat er festgestellt, dass die Metastasenbildung in den supraklavikulären Lymphknoten beim Lungenkarzinom mit der Lokalisation und dem Wachstum desselben in engster Beziehung steht und dass dieses für die Feststellung des Sitzes des Tumors sehr wichtig sei.

Über die Metastasenbildung in den rechten und linken Supraklavikularlymphknoten hat er ein Gesetz festgestellt, wonach 5 verschiedene Verbreitungsmodi zu unterscheiden sind. Nach dem ersten und zweiten Verbreitungsmodus wo der Tumor den Sitz in dem linken- oder rechten Oberlapp hat, soll die Metastase wenigstens anfangs in den gleichseitigen Supraklavikularknoten auftreten, weil die supraklavikulären Lymphknoten anatomisch mit den thorakobronchialen — bzw. peribronchialen — und mediastinalen der gleichen Seite in Verbindung stehen und diese

Lymphknoten und ihre Lymphgefäße die Hauptbahn der Lymphströmung der Lunge bilden, vorausgesetzt dass die normale Richtung durch Druck auf die Lymphgefäße bzw. auf den Lymphknoten durch den Tumor nicht gestört wird.

Wenn der Tumor von dem rechten bzw. linken Hilus oder von einem Orte in der Nähe desselben ausgeht und frühzeitig durch sein Wachstum auf die rechten bzw. linken Hauptbahnen einen Druck ausübt, so fließt die Lymphe mit den Karzinomzellen aus den rechten bzw. linken Oberlappen durch die Anastomose zwischen den Lymphoglandulae thorakobronchiales inferiores und den Lymphoglandulae superiores dextrae bzw. sinistae in die entgegengesetzten supraklavikulären Lymphknoten ein. (Verbreitungsmodus 3 und 4.) Bei dem fünften Modus handelt es sich um die gleichseitigen Metastasenbildung bei den Pleurageschwülsten.

Nach den klinischen und pathologisch-anatomischen Statistiken über die supraklavikulären Metastasen der Thorakal- und Abdominalkarzinome aus Memorial Hospital New York von VIACAVA-PACK, kamen bei 4,365 verschiedenen lokalisierten Karzinomen 122 Mal Supraklavikularmetastasen vor und zwar 59.8 % links, 25.4 % rechts und 14.8 % beiderseits.

Bei Lungenkarzinomen wurden Supraklavikularmetastasen gefunden: von VIACAVA-PACK 13.2 % (18 linksseitige, 15 rechtsseitige und 11 beiderseitige), von SUZUKI 31.4 % und von TAKINO 78.57 % der Fälle. In den Fällen von Lungenkarzinom die mein Material umfassen, wurden supraklavikuläre Metastasen in 15.7 % beobachtet worden; nur ein Fall von beiderseitigen Metastasen wurde beobachtet.

Aus der mir zugänglichen Literatur gelang es mir nicht viel vergleichendes Material zu gewinnen. Es ist doch interessant die bisher veröffentlichten Prozentzahlen der Magenkarzinometastasen in der supraklavikulären Lymphknoten (LANGE 4.29 %, LEBERT 3.42 %, LÉPINE 7.5 %, WERTHEMANN 4.3 %, POSCHARISKY 5.4 %, SCHNEIDER 7.3 %, VIACAVA-PACK 2.6 %, SUMIKOSHI 6.95 %, Berliner Krebskomitees Sammelstatistik 1.57 %, BORRMANN 0.83 %) und meine eigenen Angaben 13.94 % (bzw. 5.78 %) mit den obengenannten Zahlen der Metastasen bei Lungenkarzinom zu vergleichen. (Diagramm 1.)

Aus den Kurven geht deutlich hervor, wieviel grösser die Frequenz der supraklavikulären Metastasen bei Lungenkarzinomen ist als beim Magenkarzinom. Mehrere Autoren haben behauptet,

dass die Metastasierung zu den supraclavikulären Lymphknoten beim Lungenkarzinom viel öfter und vielleicht auch frühzeitiger auftritt, weil die Lymphwege hier viel kürzer sind als die Wege von den verschiedenen Bauch- und Unterleibsorganen.

Es ist aber beachtenswert, dass supraclavikuläre Metastasen auch bei Karzinomen anderer Bauch- und Unterleibsorgane, wie

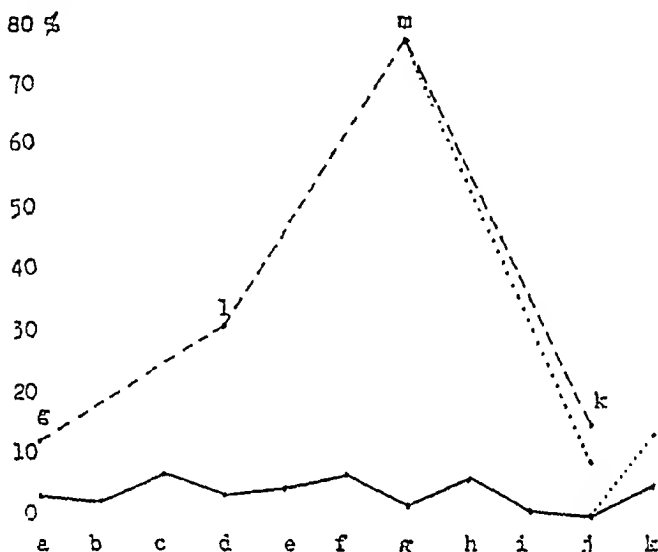


Fig. 1. Die Frequenz der supraclavikulären Metastasen beim Lungenkarzinom — — — — — und Magenkarzinom ————— nach verschiedenen Untersuchern: a = LANGE, b = LEBERT, c = LÉPINE, d = WERTHEMANN, e = POSCHARISSKY, f = SCHNEIDER, g = VIACAVA-PACK, h = SUMIKOSHI, i = Berliner Krebskomitée, j = BORRMANN, k = JAKOBSON, l = SUZUKI, m = TAKINO. JAKOBSONS mikroskopisch kontrollierte Fälle = .....

Leber, Pankreas und besonders Uterus, Ovarien und Prostata gar nicht selten sind. Wie bereits vorher gesagt, bestehen in allgemeinen hier keine begründeten Unterschiede zwischen den Metastasen der Karzinome der Genital-Organen und anderer Organe. Es sind auch Fälle geschildert worden, in denen supraclavikuläre Metastasen direkt als Anweiser für Karzinome der Genitalorganen gewesen sind.

Das Prostatakarzinom z. B. beginnt nach LUNDSGAARD nur in 50 % mit Symptomen (wie Hämaturie, allerlei Schmerzen, Retention, Inkontinenz usw.) von Seiten der Harnwege. In den übrigen 50 % deuten die Initialsymptome keineswegs auf eine Erkrankung der Prostata. Erst durch das Hinzutreten von späteren ergänzenden Erscheinungen seitens der Harnwege wird die eigentliche Natur der Krankheit entdeckt. Die Gruppe der indirekten Symptome teilt sich in zwei Unterabteilungen — von Seiten der Lymph-

knoten und des Knochensystems, d. h. die Organsysteme, in welchen das Prostatakarzinom mit Vorliebe metastasiert.

Obwohl die Metastasen nach allgemeiner Auffassung gewöhnlich als eine osteoplastische Wirbelkarzinose auftreten, sind auch

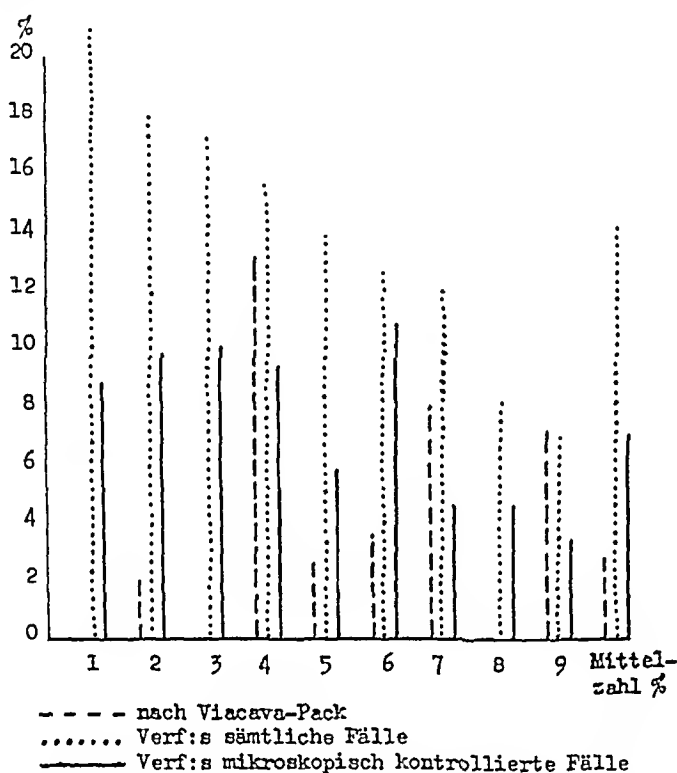


Fig. 2. Die Frequenz der supraclavikulären Metastasen bei verschiedenen Primärkarzinomen des Memorial Hospital, New York, ———— und St. Eriks Krankenhaus, Stockholm ..... (alle Fälle) und ———— (mikroskopisch kontrollierte Fälle):

1. Mammæ. 2. Prostata. 3. Hepar, ves. fell. 4. Pulmones. 5. Ventriculus. 6. Uterus, Ovarium. 7. Pancreas. 8. Intestinum. 9. Oesophagus.

Fälle beschrieben worden, in denen das erste klinische Symptom des Prostatakarzinoms eine Aufschwellung der Supraklavikulärlymphknoten gewesen ist. (CARLIER, BAUMGARTEN, LUNDSSGAARD, VIACAVA-PACK.)

Ebenso ist bei den Genitalkarzinomen der Frau die Anschwellung der supraclavikulären Lymphknoten als das erste klinische Symptom des Tumors vom mehreren Autoren wie VINCENT, BAIOCCHI, VIACAVA-PACK u. a. erwähnt worden. Die anderweitigen Veröffentlichungen zeigen, dass das durchaus nicht seltene Vorkommen von supraclavikulären Metastasen bei Genitalkar-

zinomen der Frauen wachsende Aufmerksamkeit auf sich lenkt, und wenn auch nicht als Frühsymptom, so doch als Teilerscheinung des Krankheitsbildes einen gewissen Einfluss auf die Behandlungsart ausübt und für die spätere Beurteilung ihres Erfolges massgebend sein kann (ERNST).

Beim Vergleich der Frequenz der supraklavikulären Metastasen bei den verschiedenen Formen von Primärkarzinom unseres Materials mit den Angaben von VIACAVA-PACK aus Memorial Hospital in New York in dem nächstfolgenden Diagramme (Fig. 2), muss die Tatsache beachtet werden, dass die letzteren Angaben teils von klinischen und teils von pathologisch-anatomischen Beobachtungen herkommen, die ersteren aber ausnahmslos Beobachtungen beim Sektionstisch sind.

Das ausschlaggebende Moment bei der Entstehung dieser Differenz kann auf den divergierenden Charakter des gegenübergestellten Materials zurückgeführt werden; den Sektionsresultaten kann ja die Zuverlässigkeit nicht aberkannt werden.

Es war nicht möglich nach meinem Material das erste Auftreten und Alter der supraklavikulären Metastasen zu bestimmen. In einem Teil der Fälle, wo die sogenannten Virchow'sche Drüsen vorkommen, war das Karzinom ziemlich ausgebreitet, bei anderen nur im regionären Lymphknoten.

In Memorial Hospital sind die Metastasen der Supraklavikularlymphknoten nach VIACAVA-PACK im 33.6 % der Fälle (von 122 suprakl. Metast. 41 Mal) als Anweiser eines malignen Tumors resp. Karzinoms gewesen.

Nicht ohne besonderes Interesse ist es, die Frequenz der supraklavikulären Metastasen bei verschieden lokalisierten Primärkarzinomen und die Verteilung nach Altersstufen der Patienten zu beobachten (Tabelle 2).

In der Tabelle und in den folgenden Diagrammen ist der Prozentsatz der beobachteten Supraklavikularmetastasen in Gruppen von zwei Dezennien dargestellt.

Wenn man das Diagramm, besonders das der mittleren Prozentzahl der supraklavikulären Metastasen betrachtet, könnte man hier wohl zur selben Schlussfolgerung kommen, wie bereits mehrere Autoren über Karzinommetastasenbildung im allgemeinen behauptet haben, nämlich das die Metastasenbildung bei jüngeren Jahrgängen im Gegensatz zum höheren Alter überwiegt. Die Frequenz der Karzinommetastasen ist auch in diesem Material umgekehrt proportional dem Alter.

Tab. 2.

Lokalisation	1—20			21—40			41—60			61—80			81—100		
	Karz.fälle	Met.zahl	%	Karz.fälle	Met.zahl	%	Karz.fälle	Met.zahl	%	Karz.fälle	Met.zahl	%	Karz.fälle	Met.zahl	%
Mamma...	—	—	—	5	2	40.0	27	7	25.9	21	3	14.3	4	—	0
Prost. ....	—	—	—	—	—	—	3	—	0	46	11	23.9	12	—	0
Hepar ....	—	—	—	3	3	100.0	43	7	16.3	57	7	12.3	7	2	28.6
Pulm. ....	—	—	—	1	1	100.0	71	11	15.3	49	8	16.3	6	—	0
Ventr. ....	—	—	—	14	4	28.6	75	15	20.0	188	21	11.2	17	1	5.9
Uterus {	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ovar. ....	—	—	—	3	—	0	23	2	0.8	21	4	19.4	1	—	0
Pancr. ....	—	—	—	3	1	33.3	21	3	14.3	34	3	8.8	8	1	12.5
Intest. ....	2	1	50.0	4	1	25.0	27	1	3.7	78	7	9.0	10	—	0
Oesoph....	—	—	—	—	—	—	7	1	14.3	18	1	5.6	4	—	0
Zusammen	2	1	50.0	33	12	36.4	297	47	15.8	512	65	12.7	69	4	5.8

Beim Vergleich aller mir zugänglichen Literaturangaben mit meinen eigenen Betrachtungen, scheint es wohl so zu sein, dass die Bedeutung der supraklavikulären Karzinommetastasen für die Diagnose der Karzinome oft unterschätzt wird und dass diesen Fernmetastasen viel grössere Aufmerksamkeit von Seiten der Kliniker gewidmet werden müsste als es tatsächlich der Fall ist.

Das Erscheinen des Karzinoms in den supraklavikulären Lymphknoten ist schon als Zeichen der weiten Verbreitung des Tumors im Inneren des Körpers und ist laut der Meinung mancher Autoren ein Symptom der Durchseuchung der gesamten Lymphbahnen mit Tumormassen.

Wenn nach Ansicht mancher Autoren die Rettung des Tumorträgers oder die effektive Hilfeleistung kaum zu verwirklichen

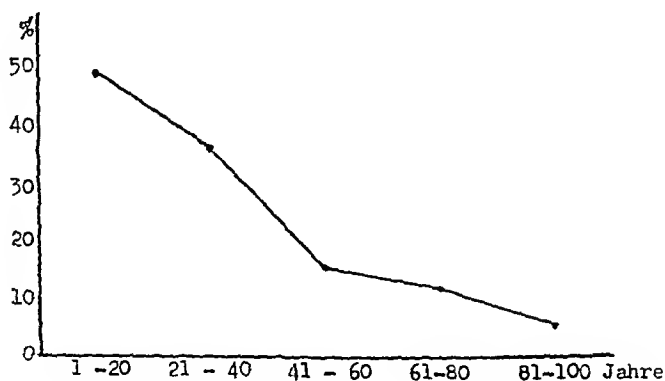


Fig. 3. Die Frequenz der Metastasen in den verschiedenen Altersgruppen.

wäre, sollte doch nichts unterlassen werden zur Ermittlung der Frühdiagnose, da die Metastasen manchmal auch als Frühsymptom zum Vorschein treten können. Besonders der letzterwähnte Zustand sollte, auch bei geringster Verdacht auf Karzinom, zur eingehender palpatorischen und mikroskopischen Untersuchung der leicht zugänglichen supraclavikulären Lymphknoten verpflichtet. Nur durch ständig steigende Wachsamkeit in der frühen Diagnosestellung mit darauf folgenden therapeutischen Massnahmen kann eine Besserung erstrebt werden.

### Summary.

An investigation is made of the frequency of the occurrence of supraclavicular lymph node metastases in various localized primary carcinomas.

Out of 914 cases of carcinoma from the autopsy material of St. Eriks sjukhus, Stockholm, there occurred in the period from 1937 to 1945 (incl.) 129 cases (i. e. 14.1 %) of supraclavicular metastases. About half of these cases were microscopically control-examined. After the localization of the primary carcinoma, the supraclavicular metastases showed the following frequency: Mamma carcinoma 21.5 % of the cases, prostata c. 18.01 %, liver c. 17.27 %, lung c. 15.75 %, stomach c. 13.94 %, uterus- and ovarial c. 12.71 %, pancreas c. 12.12 %, intestinal c. 8.19 % and oesophagus c. 6.89 %.

Bilateral supraclavicular metastases were only found in 3 cases, all the other cases were left-sided only. The distribution of the average percentage of supraclavicular metastases in all the carcinomas according to the age of the patients gave the following dates: From 1—20 years 50.0 % of the cases, from 21—40 years 36.4 %, from 41—60 years 15.8 %, from 61—80 years 12.7 % and from 81—100 years 5.8 % of the cases.

The largest supraclavicular metastases were of the size of a mandarine, resp. an orange; both these cases were observed simultaneously as a carcinoma of the stomach. The first appearance of the supraclavicular metastases as an early symptom could not be established on the basis of this material.

From the investigation is evident, however, that the diagnostic value of the consequent examination of the supraclavicular lymph nodes must not be disregarded altogether.



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From the Loimaa District Hospital, Finland.  
(Chief: EINO E. VUORI.)

## Two Cases of Primary Suppurative Psoas Myositis.

By

EINO E. VUORI.

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Primary suppurative myositis is a term used for a purulent inflammation occurring both in the parenchyma and in the interstitial connective tissue of a muscle and delimited from the surroundings by the muscular fascia, in cases which are not associated with some concurrent disease in other parts of the body. Inflammations which have spread by continuity into a muscle from purulent processes in the surrounding tissues, or metastatically from more distant parts are termed secondary myositis. The first-mentioned disease has been given many names in the course of time, thus BRUNON uses the denomination "Myosite infectieuse primitive", J. SCRIBA "Myositis acuta", B. HONSELL "primäre Myositis purulenta", H. ITO & S. SINNAKA, H. MIYAKE and G. HOLM "Myositis infectiosa", FR. KLAGES "genuine Myositis", A. DECASTELLO and O. WICHT "idiopathischer Psoasabscess", and O. SELVAAG "myositis epidemica". KADER wishes to bring all different forms under one heading "Myositis septica", as there is often no clear-cut differentiation between them.

Myositis most commonly appears in only one muscle, more rarely in several muscles, belonging to the same group of muscles or located in different parts of the body. In the latter case the disease often appears successively in the different localizations and thus acquires a septic character. The pectoral muscles and the big femoral muscles are most commonly affected. In the psoas region a primary suppurative myositis is very rare, but secondary myositis is very frequently found in this area. Only 7 cases of the former disease (with the exception of dermatomyo-

sites) have been published in Fenno-Scandia. All of these cases are from Denmark where R. MUNTKE FOG (1919), and J. C. CHRISTOFFERSEN (1946) have reported one case each, and E. SCHROEDER (1938) 5 cases collected from different hospitals in Copenhagen from a period of 38 years. The materials published in other European countries and in the United States are equally scanty. The largest series is that reported by P. INGELRANS & J. MINNE comprising 11 cases from France. However, the disease seems to be more common in warmer zones. Thus F. APPEL (1921) has published 65 cases of tropical myositis from Africa; 12 of these were located in the psoas. In 1904, 250 cases of primary myositis had already been published in Japan, according to MIYAKE, but his study does not reveal in how many cases the psoas was affected. Two cases of primary suppurative myositis treated at the Loimaa District Hospital are reported below:

*Journal No. 198/1942.* M. A., married woman, aged 22. Hospitalized from May 15 till June 1, 1942.

*Past history:* About middle of March the patient fell on her seat on slippery ice. After some days pain "inside the pelvis" started and increased daily causing a limp in the right leg. Walking was easiest in a bent position. Fever set in about the same time. The patient consulted a doctor who considered the disease rheumatic sciatic neuralgia and prescribed vitamin B injections. The disease grew worse, however, and the patient could not stand on her right foot at all. As the fever rose to 39° C., she was admitted to the local hospital on March 4. She was treated with sodium salicylate, heat (electric pillow) etc. Diagnosis: neurasthenia. On her discharge from the hospital the patient had no fever and could walk a little with a limp. At home the disease at once took a turn for the worse and the patient was brought to the Loimaa District Hospital on May 15.

*Physical examination* revealed a very thin and anemic woman, condition low. Temperature 39.6° C. Spastic flexion contracture of right thigh to about 60°. Severe pain on attempted extension. Other movements free, no pain. Abdomen soft, on right side close to the lumbar spine and in the iliac fossa a palpable mass running in longitudinal direction and extremely tender on pressure. Urine sterile, clear, only a few epithelial cells in the sediment. A radiogram of the right hip joint, the pelvis, the lumbar vertebræ, and the six lowest dorsal vertebræ revealed a slight scoliosis of the lumbar spine. The outline of the left psoas distinct, but that of the right psoas absent. In the lateral view the muscle shadow extended to the anterior part of the spine. Diagnosis: Abscessus m. iliopsoas l. dx.

May 16. *Incisio et canalisatio abscessus* (VUORI). An abscess cavity of the width of a finger in the centre of the psoas was opened from the back above the crest of the ilium and drained by means of a rubber tube. Gram's stain of the pus revealed staphylococci.

May 18. Normal temperature. Contracture relaxed. On discharge from hospital, June 1, the wound was still slightly open, but closed within about a week.

*Follow-up examination* February 9, 1947. The disease had left no kind of permanent damage.

*Journal No. 784/1945.* A. A., farmer, aged 22. Hospitalized from October 15 till November 4, 1945.

*Past history:* Three weeks previously a pain set in without any known cause on the right side deep in the lumbar region, increasing gradually. The pain made the patient limp more and more. He had not been able to walk at all for the last few days. Lying on the affected side with the knees bent was least painful. Fever probably only for a few days.

*Physical examination:* General condition somewhat impaired. Temperature 39.4° C. Right lower limb slightly flexed at the hip. Considerable pain felt on attempted complete extension, no pain from other movements. On the medial side at the base of the thigh tenderness on pressure. Abdomen soft. On the right side a similar palpable mass as in the previous case. Examination of urine revealed nothing pathological. The diagnosis Lymphadenitis suppurativa reg. psoatis was made without X-ray examination.

October 15. *Incisio et canalisatio abscessus* (VUORI): same method used as in the case described above. The cavity was only of the size of the ungual phalanx.

The temperature was normal already on October 17. On discharge from the hospital the wound had not yet closed completely and a very slight amount of thin pus escaped. After closing and reopening twice, the wound healed permanently only 3 months later, a pea-sized piece of necrotic tissue having been removed.

*Follow-up examination* by letter, March 2, 1947. The patient had been well except for a slight pain felt in the area of the scar in connection with heavy work.

*Comment:* Case 1. A few days after falling on her seat the patient's temperature rose gradually, a pain set in in the pelvic area, causing a limp in the right leg from the hip joint. These symptoms disappeared almost completely after bed-rest and heat therapy in the local hospital, but recommenced at home. On being admitted to the Loimaa District Hospital 3 months following the injury, the patient had a high temperature, her general condition was low, and there was a spastic flexion contracture of the right coxa. A palpable tender mass in the abdomen on the right side of the vertebral column. A correct diagnosis was made and a large abscess in the psoas was opened and drained from the back. The patient recovered in 3 weeks.

Case 2. Without any known cause a young man had gradually increasing pain in the right lumbar area causing a limp. Marked elevation of temperature and slight flexion contracture of the

coxa did not, however, appear until 3 weeks later. An incision was made and a small abscess cavity was found in the psoas, yet the patient did not recover completely until 3 months had passed. In both cases the bacterial causative agent was the staphylococcus. No permanent disability was observed in either case.

*Etiology.* Similarly as in these two cases the causative organism in most cases reported in the literature has been the staphylococcus, most commonly *S. aureus*. Very rarely the streptococcus, pneumococcus (LOMBARD), or Pfeiffer's *B. influenzae* (B. R. SWORN) has been the cause of the disease. The point of entry has sometimes been a small infected excoriation or an acne pustule, but in most instances it has not been demonstrable; sometimes even the tonsillae have been suspected. According to KLAGES and L. COHEN-SOLAL, also the appendix — even without a periappendicular abscess — might play a part in the initiation of the disease, and Psoas myositis being right-sided in most instances — as also in the cases reported in this paper — seems to be an evidence of this fact. Thus for instance 22 out of the 36 cases collected by SCHROEDER from the literature were right-sided (in addition there was one bilateral case and 2 in which no data were given regarding the side affected). The number of cases is so small, however, that this ratio can scarcely be used as conclusive mathematical evidence. Small hematomas arising in connection with muscle trauma are probably predisposing factors; similarly very strenuous work (HONSELL). This seems to account for the disease being more common in men than in women. The infection may spread into the muscle by the hematogenic as well as by the lymphatic route. A primary suppurative myositis, even in the wider sense, is thus a pyemic or metastatic disease, as is acute osteomyelitis. The statement has also been made that it is the equivalent in adults to osteomyelitis in children (LYOT). This statement has proved erroneous because, when the number of published cases of myositis has grown, it has been found to occur in children and in very young people even more often than in adults. Thus for instance 24 of the cases classified by SCHROEDER were children.

*Clinical picture and course:* The most important symptoms of the disease are: fever, often high and of septic type, a consequent impairment of the general condition, a swollen and tender muscle tumour without peritoneal irritation, but accompanied by a

spastic flexion contracture of the coxa slightly rotated outwards. Attempted extension of the thigh causes severe pain, whereas other movements are comparatively free and painless. The last-mentioned symptoms may be regarded as pathognomonic of this disease. Already within a few days an abscess cavity may arise in the muscle, generally only one big cavity, more seldom several small ones. INGELRANS & MINNE assert that when the origin of the infection is in the kidney the abscess develops in the upper part of the muscle, when in the appendix, it develops in the middle part of the muscle and similarly when originating from para-aortic lymphadenitis. When the infection starts from the lower limb, the lower part of the muscle is affected. Besides the foudroyant type of the kind described above, which in the severest cases may rapidly lead to gangrene of the whole muscle, to metastases in other muscles, or to general sepsis, cases with a less stormy course are also encountered; the two cases described in the beginning of this paper were of the latter type. After developing to the stage of diffuse purulent inflammation with only slight symptoms the disease may also heal without abscess formation. This would probably have happened in Case 1 if the immobilization during the first stay at hospital had been long enough. After setting in acutely the disease may also become a chronic recurring indurative process (CHRISTOFFERSEN's case).

Regarding *complications* it may be mentioned that a collateral periurethritis or a displacement of the kidney due to swelling of the muscle may cause a temporary hydronephrosis (E. DAMM, SCHROEDER, CHRISTOFFERSEN). The abscess may also perforate into the free abdominal cavity causing peritonitis, into the intestines or the bladder, or penetrate below the inguinal ligament to the trigonum Scarpae. DECASTELLO has described a case in which an abscess perforated through the foramen intervertebrale into the dural sac, giving rise to a meningitis which ended fatally. Remote complications are metastatic pneumonia, pulmonary infarct, endo- and myocarditis, and renal abscess (HOLM). Metastasis through the vertebral venous system into the brain does not seem to be impossible (the author has seen a case of cerebral infected embolism as a result of tuberculous spondylitis fistulating via the inguinal fold). It is clear that such complications are not found until comparatively late, and principally in cases for a long time not properly treated, due to wrong diagnosis etc.

The *diagnosis* is based on recognition of a tender muscle tumour in the posterior wall of the abdomen close to the lumbar spine and in the iliac fossa, and on the flexion contracture of the coxa, the attempted extension of which causes the only, or at least the most marked, pain elicited.

In the *differential diagnosis* the following diseases should be considered: purulent coxitis, abscesses descending from tuberculous or non-tuberculous spondylitis, osteomyelitis of the ileum, purulent iliosacral arthritis, and periappendicular and pararenal abscesses. On the other hand, there should be no possibility of mistaking the condition for sciatic neuralgia, as in Case 1.

All the bone and joint diseases mentioned should be easy to differentiate, at least in all somewhat far-advanced cases, on the basis of their characteristic radiographic changes. Psoas myositis, on the other hand, causes only an unusually large muscle shadow, less distinct in outline, to appear in the radiogram, and possibly a displacement of the renal shadow in the lateral direction (G. A. B. WALTERS, DAMM, W. F. Mc KENNA, SCHROEDER). The flexion contracture caused by coxitis is rotated inwards and tender on all movements, but especially on ab- and adduction, while that caused by psoas abscess, as mentioned already, is rotated outwards and tender only on attempted extension. In the uncommon, infectious iliosacral arthritis, pain is caused by all pelvic movements, and particularly by compression of the pelvis. In addition, there is, in the area of the readily palpable posterior border of the joint, a severe and tender swelling. Osteomyelitis of the ileum is accompanied by pain in the bones and tenderness on pressure and percussion in the spinae and crista, a psoas abscess, on the other hand, sometimes by the same symptoms in the trochanther minor (GANGOLPHE's symptom). It is characteristic of descended abscesses originating from a tuberculous spondylitis or a tuberculous kidney that they wander downward towards the inguinal fold between the peritoneum and the muscle without irritating the latter and causing a contracture. The differential diagnosis is thus easy in this respect.

Periappendicular abscesses do not cause contracture of the psoas as a rule, not even always in retroperitoneal cases; in most instances, however, they show some kind of symptoms of peritoneal irritation. If an error takes place in the differential diagnosis, it may be fatal, as these abscesses are generally treated conservatively.

A pararenal abscess, on the contrary, may cause even a severe psoas contracture. (This the author is able to prove from personal experience. In his pararenal abscess arising as a complication of paratyphoid the most striking symptom was actually the flexion contracture in the coxa which was tender on attempted extension. In spite of this contracture (and urine infection!) the condition was mistaken, not for a psoas abscess but — because the pains were localized in the hip joint — for septic coxitis.) — The differential diagnosis is rendered more difficult, particularly when pararenal abscesses are located low down, by urine infection and its symptoms being absent in the great majority of cases (as demonstrated quite recently by F. FRANZAS), and by the fact that, on the other hand, pus cells may be present also in the urine of a patient with a psoas abscess (S. BEHRMAN). In addition, both these diseases may set in following trauma and may accordingly have a similar past history. We know that a part of the pararenal abscesses take their origin from pyonephrotic, hydronephrotic, tuberculous, actinomycotic, or nephrolithiatic kidneys. As in such cases the basic disease can generally be recognized by routine renal examination, it should by no means be neglected, particularly if the differential diagnosis between psoas abscess and pararenal abscess is doubtful. If the kidney proves to be healthy, the treatment of both diseases is identical. Even a wrong diagnosis will not then do any harm; it is known anyhow that the kidney must be spared.

*Treatment* consists in extraperitoneal incision and draining of the abscess. The incision is made from the back above the crest of the ilium, if the position of the abscess is high, but from the front in the case of low abscesses. As the incision canal may be fairly long in the latter instances, it must also be sufficiently wide. In Case 2 healing was probably prolonged by too narrow drainage. For obtaining the most favourable results it may be advisable to make a contra-aperture by combining the two procedures. The contracture then generally relaxes at once without any further measures. As the causative organisms are generally staphylococci, more seldom streptococci, and only in rare instances other bacteria, recovery may probably be brought about by sulfonamides and penicillin alone, if administered at a sufficiently early stage, in mild cases and especially if no abscess has developed as yet. Unfortunately no sulfa drugs had been administered in Case 1 at the first hospital; in Case 2, which developed slowly, earlier



hospitalization would have been important. In severe septic cases sulfa drugs and penicillin are a valuable aid to surgical treatment and improve the prognosis. Also X-ray treatment, similar as in the treatment of hidradenitis and periappendicular abscess, may be considered.

The *prognosis* is generally good — 100 per cent quoad vitam and quoad functionem — if the patient receives proper treatment. The disease usually heals without leaving any permanent damage. This was the case also in the two instances described in the beginning of this paper. No appreciable disability was noticed even in CHRISTOFFERSEN's chronic recurrent case. The 4 fatal cases reported by SCHROEDER were conservatively treated after a wrong diagnosis had been made, and the disease was recognized only on autopsy.

### Summary.

After pointing out that primary purulent myositis is an uncommon disease, particularly in the psoas, the author reports 2 cases of psoas abscess treated by him. In one case the disease set in following trauma, but in the second no etiological factor could be recognized. The bacterial causative agent was the staphylococcus in both cases. Incision and drainage was used and both cases healed without leaving any disability. When describing the clinical manifestations of the disease, the author deals chiefly with the differential diagnosis.

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## Subcutaneous Retroperitoneal Duodenal Rupture.

By

GUNNAR K. LAURITZEN.

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Subcutaneous retroperitoneal duodenal rupture (S. R. D.) is a rare lesion with a bad prognosis. Thus practically all the cases which have recovered have been considered worthy of publication and through the slowly accumulating material of often widely divergent case histories observations may be made and conclusions drawn for the benefit of future patients.

In Sweden SÖDERLUND in 1918 gave a comprehensive description of S. R. D. and reported a case with fatal outcome. In 1926 SANDAHL from Sahlgrenska Sjukhuset reported the first case with recovery after operation in this country. LIEDBERG in 1941 mentioned a second case which recovered and gave in 1942 a detailed report of its very instructive course. He also reported a lethal case, in which the rupture was not demonstrable, nor was it possible to determine whether it was localized to colon or to duodenum.

As a contribution to the casuistics a third case with recovery, operated at the Department of Surgery II of the Sahlgrenska Sjukhuset, is hereby presented.

### Case History.

A twenty-two-year old male student was admitted 10/23 1946. He had at football been hit by a knee in the epigastrium and had immediately felt severe abdominal pain and nausea. The pain was continuous and was mainly generalized to the entire abdomen, although it at times was felt in the upper part only. No vomiting. On admission to

the hospital two-and-one-half hours after the trauma the patient was somewhat pale although the lips were red. The pulse was well filled with a frequency of about 80. Blood pressure 135 mm Hg. The patient complained of pains in the entire abdomen which on palpation was soft and practically non-tender to the left of the midline. To the right of the midline, particularly in the upper abdomen, he reported pronounced tenderness diminishing towards the flank. After a while he also reported tenderness in the left part of the epigastrium. After a vomiting attack producing usual gastric contents and no blood, the abdomen again became soft and non-tender to the left of the midline but remained tender on the right with a moderately pronounced muscular defense. The abdomen did not give the impression of peritonitis and the absence of tenderness per rectum was noted. The patient was not in so severe shock as would have been expected in the case of intraperitoneal hemorrhage, but the continuous pain of quite pronounced severity was considered to motivate an explorative laparotomy, with the chief suspicion of a lesion of the bile ducts.

*Operation (the author) (not quite four hours after the trauma).*

*Laparotomy + suture of the bowel + extraperitonealization + drainage.*

Upper midline incision. A small amount of clear colorless fluid is found in the abdomen. Immediately to the right of the midline the transverse colon presents a rupture of the serosa 5 cm in length, which is repaired with interrupted sutures. In the mesocolon a number of small hemorrhages are observed but no large hematoma. It is remarkable that the posterior peritoneum seems to be elevated by a glassy edema. With duodenum in mind this is freed in the aboral direction as far as is possible, peritoneum is divided to the right of pars descendens and freed by blunt dissection, upon which abundant edematous fluid appears. On dissection towards the midline the retroperitoneal tissue reveals an increasingly dirty grayish brown discoloration. No duodenal lesion, however, is found, wherefore colon is pushed upwards and the small intestines are pushed to the right. Through another incision of peritoneum immediately anterior to the duodenojejunal angle the remaining portion of duodenum is examined. A similar edema and discoloration of the tissue is present here and some small gas bubbles are pressed forth. Finally the dissection made from the right side is reached and a rupture of the posterior duodenal wall about 4 cm from the angle is glimpsed. By means of sutures the bowel is rotated so that a more than  $1\frac{1}{2}$  cm long transverse rupture becomes accessible. The appearance of the bowel wall is in other respects normal. The defect is sutured with double rows of interrupted sutures of catgut and silk, respectively. Remnants of a meal of baked beans are removed from the tissue. An attempt is made to establish an extraperitoneal drainage in consideration of its great advantage. Thus, the left peritoneal incision is stitched to the anterior abdominal wall as in the case of a marsupialization; this is done without difficulty and a pair of cigaret drains left in the wound. The primary peritoneal incision is closed. Abdominal wall suture.

Following the operation the general condition was excellent and the abdomen soft. The patient did not complain of pain and did not vomit. The drain was removed by degrees, being entirely removed on the fifth day. A small amount of serous exudate was drained during the first two days. After removal of the drain the wound was dry. The patient was allowed out of bed one week following operation.

On 11/1 a profuse secretion, markedly bile-colored, commenced to flow from the operative incision. A tube with continuous suction was applied superficially in the wound. After one week the secretion had entirely ceased. On 11/13 the patient was discharged with a dry wound and was when seen at follow-up examinations after one and two weeks, respectively, still healed. He was dismissed as cured 12/2.

In regards to the administration of fluids and food after the operation the same principles were followed as in the case of a routine stomach resection. The plasma albumin, plasma chlorides and carbon dioxides of the plasma showed normal values. During the first days following operation the patient received altogether 8 g of sulfathiazole by the intravenous route.

The anatomical conditions present in S. R. D. are specific and the course usually develops as fatally as that of intraperitoneal intestinal ruptures. The diagnosis is liable to be delayed due to the absence of the abdominal symptoms, usually so alarming in intestinal ruptures, and the prognosis suffers accordingly. Only in exceptional cases does the patient survive for a short or more prolonged period without operation (SPERLING-RIGLER, FURTWAENGLER, J. HINTON), or after a purely palliative operation (BETTO, D. HINTON).

Exhaustive reports of S. R. D., with consideration of the characteristics of this lesion, have been presented by among others HERTLE 1907, MEERWEIN 1907, SCHUMACHER 1910, MILLER 1916, MELCHIOR 1917, SÖDERLUND 1918. Statistical surveys have been published by SCHUMACHER 1910, GUIBÉ 1910, MILLER 1916, SÖDERLUND 1918, D. HINTON 1940, JOHNSON 1944 and others.

In order to illuminate the frequency of S. R. D. figures from the various materials have been assembled in Table I, giving an approximate conception of the frequency of all intestinal ruptures by blunt trauma of the abdomen, and of the relative distribution hereby of lesions of colon, the small intestines and duodenum. The latter lesions are subdivided into intraperitoneal and retroperitoneal cases, *i. e.*, without a primary perforation to the peritoneal cavity. The figures are, as in all statistics on S. R. D., approximate, as various conceptions and evaluations of the different authors are set forth and detailed reports of the appearance of

Table I.

*Abdominal Trauma. Bowel Injuries.*

Author	Abdominal Contusions	Intestinal Ruptures	Colon	Small Intestines	Duodenum	
					Intra- per.	Retro- per.
MAKINS (1899) ....	292	21	—	—	—	—
HAHN (1899) .....	133	22	—	—	—	—
PETRY (1896) .....	—	198	26	163	9	0
TAWASTSTJERNA (1905) .....	—	170	19	142	9	0
HERTLE (1907) ....	—	123	11	100	5	7
SCHUMACHER (1910)	—	—	—	—	48	24
GUIBÉ (1910) .....	—	—	—	—	91	26
D. HINTON (1940) .	—	—	—	—	128	74
JOHNSON (1944) ...	—	—	—	—	—	98

the lesion in some cases are lacking. Owing to the smallness of the material each case is as yet an individual problem with variations in the age and general condition of the patient, coincident trauma, the point of time of the operation, the distribution and position of the injury, operative technic, complications, and late complications, etc.

The etiology of the lesion is usually conditioned by the patient's occupation, this being the case generally in all intestinal ruptures. LIEBERG has in regards to intestinal ruptures, irrespective of the site, pointed out that in his neighbourhood with rural population the kick of a horse has been the cause in 60 per cent of the cases, as against 4 per cent in Los Angeles, where motor vehicles on the other hand cause 68 per cent of the lesions. Explosions, especially in the water, have of late been reported from the United States as causing intestinal rupture, the mechanism being considered to be a sudden intra-abdominal increase of pressure, resulting in rupture of the bowel, an origin which by MILLER and others previously was considered exceptional. These ruptures are considered to have a site of predilection especially to the fixed portions of the bowel in analogy with intestinal rupture *ad modum* Bunge (cf. LIEBERG!) Duodenum lies attached and confined under the mesenteric root and forms, owing to pylorus, a closed system (JOHNSON). Experimental investigations have been done on this, with the findings that such a rupture is comparatively amenable to surgical therapy, the margins of the wound being smooth. In the most commonly occurrent mechanism, namely compression against the spine, a lesion more

Table II.

*Position of Injury according to Guibé (quoted by D. Hinton).*

Position	No.
Pylorus .....	7
First portion of duodenum .....	16
Second portion of duodenum .....	20
Third portion of duodenum .....	22
Junction of second and third .....	8
Fourth portion of duodenum .....	4
Duodeno-jejunal angle.....	32
Total	109

difficult to evaluate usually ensues, carrying a greater risk for bursting after suturing or secondary gangrene (MEERWEIN, KELLER 2) or for peritonitis sine perforatione (PILLIET, LIEBERG 2).

The site of the duodenal rupture, whether on the anterior or the posterior wall, appears to be of minor importance from a practical point of view, and can barely be discerned from the literature (SÖDERLUND). Of greater interest is GUIBÉ's tabulation, from which it appears that the second or third portion of duodenum are involved in approximately 50 per cent of the cases (Table II, cit. D. HINTON), of which every second case is entirely retroperitoneal, which is in good agreement with SCHUMACHER's report that about 25 per cent of the duodenal lesions are retroperitoneal.

As a rule young males between ten to thirty years of age are injured, thus usually not particularly difficult to operate upon from a technical point of view.

Generally speaking, it may be considered that the course of S. R. D. is very similar to that of a perforative peritonitis, even when the peritoneum has not primarily been injured. In the majority of the cases death occurs within forty-eight hours if nothing is done, whether the terminal cause is due to a secondary peritonitis or to an intoxication from the retroperitoneal phlegmon which spreads over large areas (to the flanks, the inguinals, pelvis, etc., cf. PETRÉN). The greatest difficulty lies in making an early diagnosis and from all sides is pointed out the insidious course with frequently an initial period without discomfort, or with but slight symptoms, after which the patient may walk in to the physician. Perforative peritonitis, often with a quite similar initial stage, is generally easily diagnosed, but S. R. D., as



aforementioned, is fully as important to bear in mind, the mortality of this lesion, not least owing to the delays, being many per cent higher. The consequence of this should be to operate on wide indications in cases of trauma towards the upper portion of the abdomen or towards the umbilical region, especially in the case of a blow directed upwards. It is true that SÖDERLUND, among others, points out that the circumstances and the symptoms of a serious lesion are so conspicuous that there can not be much doubt as to whether to operate or not, but there have unfortunately been many cases, especially in the early literature, where operation has been delayed.

X-ray examinations only rarely support the diagnosis by demonstrating a retroperitoneal emphysema, especially proximal to the right kidney (SPERLING-RIGLER).

As regards the operative technique explicit directions have been given from many quarters (HERTLE, SCHUMACHER, MILLER, MELCHIOR, SÖDERLUND, DECOULX). There may be some question of whether to perform a resection, possibly with an accompanying anastomosis, or to rest content with a simple suture, possibly with a supplementary gastro-enterostomy. In regards to resection the general opinion is that this wider procedure should be reserved for extensive lacerations and for those ruptures which come to late operation. SÖDERLUND draws an approximate 12 hours limit to the period of time after which resection should come into consideration, the digestion of the bowel wall and other tissues making simple suture increasingly hazardous, but recommends, however, an individual evaluation from case to case. In the case of an older rupture the patient's general condition is often so impaired that the operation must be rushed and in some instances restricted to drainage only, which, however, has not yet led to recovery.

In the case of a simple suture of the rupture, which naturally must be done without tension, there has been much discussion as to whether also to perform a gastro-enterostomy. There is definite indication for this when a stenosis has ensued following the suturing. A stenosis has in some cases appeared secondarily, necessitating a renewed operation. (KRASKE, KÖHLER, LIEDEBERG, OBERTHUR, D. HINTON.) The intention to relieve the suture through a gastro-enterostomy is, however, not effective, as regardless of this the main part of the food often passes through the usual route, the anastomosis in some instances even occluding.

Animal experiments have also shown this (BRAUN). SCHUMACHER and others have supplemented the procedure with a stenosis of pylorus, which in some cases has been unreliable (FURTWAENGLER), wherefore a division and closure of pylorus is recommended. SÖDERLUND does not deny the value of a gastroenterostomy but considers that the general condition of the patient should determine whether the operation should be prolonged. SANDAHL stresses instead the importance of complete alimentary abstinence. LIEBERG considers that a gastrostomy ought to bring about the result desired, and JOHNSON recommends a duodenal tube.

An argument against G. E. is, naturally, that every prolongation of the operation should be avoided, and there is also some danger of secondary peptic ulcers, which complication is well known since early days. LIEBERG's patient, upon whom G. E. was carried out secondarily for stenosis, developed this disagreeable complication and with repeated perforations as sequelae. BRAUN and STRUPPLER therefore advise, that, if a G. E. is to be carried out, this is to be done following the stomach resection according to Billroth II with anterior G. E. and enteroanastomosis. Their opinion is supported by two cases with favorable outcome. In one of the cases, however, the resection had been performed earlier. This proposition, however, involves a considerable prolongation of the procedure and ought only exceptionally to come into consideration. Generally speaking the least intervention possible should be preferred, and concerning lesions involving Vater's papilla, where comprehensive and technically difficult procedures have been discussed (SCHUMACHER, MELCHIOR, and others), MILLER's proposal seems attractive, namely, to repair, as well as may be done and take the risk of a duodenal fistula, that eventuality being treated secondarily. That this is feasible is shown in CHEEVER's case (cit. MILLER).

In Table III have been tabulated the various operations performed, as well as their outcome. The figures are based on the casuistics of SCHUMACHER, MILLER, and JOHNSON, with the additional 4 cases contributed by the author. SCHUMACHER's reports, however, are reduced according to SÖDERLUND's correction. No conclusions can be drawn, owing to the divergencies between the cases etc.

The route to be chosen for exploration of, or operation upon, the duodenum is a matter of taste. Both routes, either from the

Table III.

*Treatment of S. R. D. (Schumacher—Miller—Johnson—Author.)*

Operations	Cures	Deaths
Simple suture .....	20	12
Suture + omentoplasty .....	1	1
Suture + G. E. ....	3	4
Suture + jejunostomy (ev. secondary) .....	1	2
End-to-end .....	2	1
Do. + stomach resection acc. to Billroth II .....	1	—
Closure of duodenal ends + G. E. ....	—	2
Resection of duod. + duodeno-jejunostomy .....	1	1
Resection of duod. + duodeno-jejunostomy + E. A. ....	1	—
Resection of duod. + duodeno-jejunostomy + G. E. ....	1	—
Tamponade .....	1	1
Explorative laparotomy ev. + drainage .....	—	32
Cases operated	32	56
Continuous duodenal suction, ev. + sec. G. E. ....	2	—
No measures taken .....	—	8
Cases not operated	2	8
Total	34	64

In 22 out of 88 operations the rupture has been missed and has in 2 additional cases necessitated renewed intervention.

right above mesocolon or from the left below it at the duodeno-jejunal angle are practicable. The site of the lesion indicates the line of action. In the case of the author exploration from the left proved to be preferable and there was no danger for the colon vessels at any point of the procedure.

Drainage seems advisable in all cases both for the sake of infection and because of the unreliability inherent with suture of intestines without serosa. The method of the author was once previously used by HELFERICH in a case which also recovered (HAMANN).

The fact that the rupture has been overlooked at operation in about every fourth case (Table III) despite the typical picture shows that this lesion is not commonly recognized. It is only natural that the presence of other lesions (rupture of liver or spleen, fat necroses or other intestinal ruptures) may divert attention, although this does not seem to have been the case in more than one instance out of six (JOHNSON).

In those cases, but above all if the abdominal cavity only contains a small amount of clear fluid and otherwise seems free

of lesion, the presence of a retroperitoneal edema over the duodenal region, often with a translucent color suggesting underlying blood or bile, and often with a palpable or visible emphysema, is practically univocal with duodenal rupture and indicates a careful retroperitoneal exploration, as even four duodenal ruptures have been known to occur simultaneously (DICKSON, cit. D. HINTON). Among other symptoms VON WINIWARTER calls attention to the typical symptoms of petechiae or fat necroses over the ascending and transverse colon or the mesentery.

Occurrent complications (besides peritonitis and retroperitoneal phlegmon) have been abscesses in various sites, local, subphrenic, etc., duodenal-, pancreas-, and colon-fistulae, stenosis of duodenum or the biliary ducts (WARFWINGE) and also pulmonary affections, the latter, however, but infrequently. A certain risk for rupture of the abdominal wound has been reported, wherefore drainage through a separate incision has been advised (JOHNSON).

The prognosis for non-operated cases is considered definitely bad, as only a few have recovered. FURTWAENGLER, however, has shown that the diagnosis sometimes may be made several months later, on the appearance of a duodenal fistula. One patient even lived with a traumatic duodenal fistula for twenty years before his condition became fatal (J. HINTON). In some cases a condition progressing to death has developed either through a secondary rupture of the traumatized section or because of the invasion of infection without a demonstrable rupture (PILLIET, LIEBERG 2). THOMMEN's case and KELLER's case 2, on the other hand, recovered after resection of a loosened duodenal section without definite rupture but would undoubtedly have succumbed without operation.

That tamponade only (BETTO) or G. E. (D. HINTON) or duodenal suction (SPERLING-RIGLER) have led to recovery may be considered exceptional.

As regards the operated cases the prognosis is very guarded. The majority of the recoveries have been operated upon within from ten to twelve hours after the trauma. From Table IV it appears that there is some tendency towards improvement of the prognosis. The statistics for 1940 and 1944 for the total material show recovery for approximately 32 per cent. The figures, however, do not render the present diagnostic and operative technique full justice, which is evident if D. HINTON's and JOHNSON's figures for

Table IV.

*Prognosis of subcutaneous retroperitoneal duodinal rupture.*

Author	No. of cases	Cures	Per cent
GUIBÉ (1910) .....	26	2	7.7
SCHUMACHER (1910) .....	24	2	8.3
MILLER + SCHUMACHER (1916) .....	46	5	10.9
SÖDERLUND (1918) .....	37	5	13.5
D. HINTON + GUIBÉ (1940) .....	85	27	31.8
JOHNSON + MILLER + SCHUMACHER (1943) .....	98	31	31.7
D. HINTON (1910—1940) .....	59	25	42.4
JOHNSON (1916—1943) .....	52	26	50.0

the years 1910—1940 and 1916—1943 respectively, where nearly 50 per cent seem to have recovered, are studied. BRAUN (1941) is far more pessimistic and calculates with a mortality of about 90 per cent. He also points out, in agreement with other workers, that it is the recoveries which come to publication, and that there probably are far more deaths than it would seem. This may of course to some extent be possible, but surely the number of fatal cases published intimates that the interest for this rare trauma with its universally recognized gloomy prognosis has overcome the possible consideration of a loss of personal prestige.

To the cases reported in the latest statistic by JOHNSON 1944 may be added a case each from LIEBERG 1942, SARNOFF-OREMLAND 1943, TRAFFORD 1944, and the personal case of the author. TRAFFORD's case died from pneumonia without peritonitis, the remaining three recovered.

### Summary.

Subcutaneous retroperitoneal duodenal rupture (S. R. D) is a rare lesion with a bad prognosis.

Report of a personal case with favorable outcome, treated with bowel suture and drainage as well as with extraperitonealization by suture of the anterior to the posterior peritoneum. This method has been employed once previously and also with recovery. The present case is the third recovery reported in Sweden.

Owing to the rare occurrence of this trauma (illustrated by tables) there is no course which may be considered typical, practically every case having its distinct problems. The etiology is oc-

cupationally determined, but tends in our day to be debited to motorism. Of late, war injuries, especially explosions in the water, have been reported to result in a well defined rupture, easily amenable to suture.

S. R. D. is in 50 per cent of the cases localized to the second and third portion of the duodenum.

The diagnosis is difficult because of the absence of the symptoms of peritonitis, usually so alarming in intestinal rupture. X-ray examination only seldom gives information by revealing a retroperitoneal emphysema. Without operation the course is nearly always fatal. The indications for explorative laparotomy is influenced by the fact that early operation decides the prognosis. A serious internal lesion is generally easy to suspect.

At operation a retroperitoneal edema, usually translucent and suggesting underlying blood or bile, and a palpable or visible emphysema suggest duodenal trauma. The recognition of this is important, as in approximately every fourth case the picture has been interpreted as a contusion and the lesion has not been detected. Coincident lesions must not distract due attention. A most careful exploration of the entire duodenum must be done, as several ruptures may occur simultaneously or a non-perforating lesion of the wall or a loosening of the bowel may be present, carrying the risk of a secondary perforation.

It appears from a tabulation that simple suture most frequently has been done. Each case, however, must be treated individually also in regards to palliative or prophylactic measures. The least intervention possible should be the aim. Drainage is advisable also in the case of conditions favorable to suture.

The prognosis is precarious. The total material shows recovery in about 32 per cent of the cases. For the material of the latest 35 years only the figure seems to be improved and amounts to recovery in about 50 per cent of the cases. Possibly, however, these figures may be unduly favorable, as cases with a lethal course may not have come to publication.

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For more detailed literature see HERTLE, SCHUMACHER, MELCHIOR and JOHNSON!

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## Treatment of Skin Avulsion Injuries of the Limbs.

By

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By discussing the following ten cases of skin avulsion injuries of the limbs, the author hopes to draw wider attention to a rational treatment of these lesions — the method of treatment which has been employed for many years by Sir HAROLD GILLIES in England.

Skin avulsion is not an uncommon lesion and one expects that the number of cases of this type of injury will increase as life returns to pre-war conditions, and ever increasing mechanisation in industry and farming, as well as increasing number of motor vehicles on the roads, produce their quota of accidents.

Concerning the mechanism of avulsion, one should note the fact that the skin, with its subcutaneous tissue, is fairly loosely attached to the underlying deep fascia, allowing the skin a certain degree of mobility. If the skin is subjected to a tangential force, it will start sliding on its base and, if the force is severe enough, the attachment to the underlying fascia will be torn. That these attachments are not very firm may be readily observed when bluntly undermining a wound edge to expose the fascia, or on lifting a skin flap. Should the force continue its action, the skin will be stretched to the limit of its elasticity and, when this limit is exceeded, the skin will burst, thus allowing final displacement in the direction of the force.



Thus, on a limb subjected to a tangential force, the skin may burst in an annular fashion and may be peeled from the limb in a manner comparable with pulling off a glove or a stocking. This is the origin of the name "glove or stocking" lesion applied to this type of skin injury.

What will now be the fate of the avulsed skin? If it has been entirely detached, all circulation will obviously have been destroyed. If the skin is still hanging by a small bridge, it will be obvious that the narrow base is too small to have a chance of providing anything approaching an adequate blood supply. If, on the other hand, the flap has a fairly broad base, many surgeons will feel a strong temptation to sew the flap back into normal position, trusting the blood supply will be adequate. On rare occasions this manoeuvre may succeed but most surgeons will have had the sad experience of observing the flap going blue and finally black in the course of the following two or three days, with subsequent sloughing.

Why does a skin flap with an apparently good base die when a similar flap, lifted surgically in a plastic operation, survives? The answer is to be found in the actual handling of the flap. Everyone, with experience in making skin flaps for plastic surgical repairs, is familiar with the great care necessary in handling flaps to avoid disastrous gangrene. Undue pinching, stretching or kinking may lead to partial or complete necrosis. Obviously, the avulsion of a skin flap in a car accident implies extremely rough stripping of the flap. The skin flap is violently torn down and crumpled up at its base with severe kinking and then may be left in its displaced position for a few hours before the patient receives any surgical treatment.

During this period, the elastic recoil of the skin causes compression of the veins in the flap (this observation is frequently made in cutting a skin flap. When the flap is freed, it becomes blue in colour, a sign of difficulty in venous return, but, as soon as the flap is sewn into its new position and stretched to normal skin tension, the pink colour returns). Thus, by the time surgical aid is forthcoming, the veins may have thrombosed, due to the initial trauma, and the venous obstruction produced by the elastic recoil of the skin. Another factor hampering venous return is that avulsion flaps commonly have their base directed distally, on the limb so that the direction of venous flow has, therefore, to be reversed before normal drainage is secured. The natural valve

mechanism of veins may be an obstacle to securing this reversed flow.

The above factors all tend to impede venous return from the flap while arterial inflow to the flap is obstructed to a lesser degree. The flap assumes a blue colour and starts to swell, the swelling further hampering the already reduced venous return. The end result is a flap engorged with blood and lacking venous drainage. This situation culminates in necrosis of the flap.

If no other treatment is instituted, the patient from now onwards is in the same category as a patient suffering from burns. The dead tissue will separate as a slough, leaving a granulating area which will heal slowly from the edges — a process which may take many months. The healed "scar epithelium" contracts as it matures, and may produce severe deformity in the neighbourhood of a joint. (See Case I.) Again, the "scar epithelium" is so thin and so poorly nourished that breakdown and chronic ulceration may easily follow the trauma. Such chronic ulceration is not easily treated by skin grafting as the thick scarring of the base, deep to the granulations, provides a very poor blood supply.

In order to minimise disability, the treatment of skin avulsions should aim at restoring skin continuity as quickly as possible and to prevent the formation of scarring with its liability to production of deformity. As has already been pointed out, the simple resuture of an avulsed skin flap into position is unlikely to be successful and this procedure should be condemned altogether. Two other methods of treatment are available. The avulsed skin flap may be entirely removed and the skin defect restored by free skin grafts, or the avulsed flap itself may be converted into a free skin graft by complete removal of its subcutaneous tissue and then replacing it on the raw area. The second method should not be used when the skin of the avulsed flap has been severely abraded or lacerated, or when many hours have elapsed before the patient comes under treatment and incipient gangrene is already present in the flap. A third method of treatment is occasionally indicated when the avulsion exposes bared tendons and bone. In those cases, free skin grafting is unlikely to be adequate and a better plan is to cover the raw area, or the essential part of it, with a direct skin flap from the abdominal wall or from the opposite limb.

The case records of the following ten cases may serve to illustrate the method of treatment of avulsion injuries:

*Case No. 1* is a boy, five years old. On 1st April 1940, he was run over by a bus and received extensive injuries to his left arm. The skin was degloved from near the shoulder to the wrist. The musculo-spiral nerve was totally destroyed for two inches. The muscles were torn and avulsed, especially the triceps and the brachio-radialis group. Some of the origin of the common extensor group was destroyed. There was also a fracture of the middle of the ulna.

Under general anaesthesia, the wound was cleaned, the musculo-spiral nerve was sutured and *the skin brought together*. Following the operation, part of the skin flap became gangrenous and a large granulating area was left.

Now follows a period where the patient shows very slow improvement with septic intervals. On the 4th October, there seems to be a turning point and the raw area is healing more rapidly and on 12th December 1940 his record reveals that the arm has healed but with a stiff elbow in 120° flexion contracture. The condition at this stage is clear from the photograph taken on 17th December — five days after the patient had been transferred to this hospital for treatment. Attention is drawn to the fact that this patient had an open, granulating wound on his arm for 7—8 months and that the end result of this slow healing process is a useless arm, even if one leaves the radial palsy out of the picture.

On 18th December 1940, the patient had his first operation (Sir HAROLD GILLIES and Mr. J. B. CUTHBERT). All the scarred skin and deep sear tissue was excised. A direct abdominal flap was raised and sutured into the defect after extending the elbow joint. The raw area on the body was not grafted and the condition at this stage is illustrated by the photograph taken on 3rd January 1941. (Plate I).

On 5th January 1941 the abdominal attachment of the flap was divided.

On 6th February 1941 the large granulating area on the abdomen from which the flap had been lifted was covered with Thiersch grafts. On 16th April it is recorded that he is well healed. Photograph from the 2nd February shows the flap well healed on his arm and almost full mobility in the elbow joint.

The patient was then transferred to a peripheral nerve unit for treatment of the nerve lesion.

This case is illustrative in demonstrating how the incorrect treatment confines the patient to 7—8 months hospital treatment with the final result: *a useless arm*. If the plastic surgical treatment had been started straight away, the patient might have been discharged from hospital after 3—4 months with a healed arm and full mobility of the joints. The age and the size of the patient made the treatment of the donor area on the belly wall a difficult problem. The area was, therefore, left until the flap was safely established on the arm. This explains the diffi-

PLATE I.



17.12.40.



3.1.41.



2.2.41.



19.4.41.



5.2.41.



5.2.41.

*PLATE II, Case Nr 2.*



5.5 41.



6.6.41.

*PLATE III. Case Nr 3.*



9.5.42.



17.6.42.

SCHJELDERUP: Skin Avulsion Injuries.



25 1 46



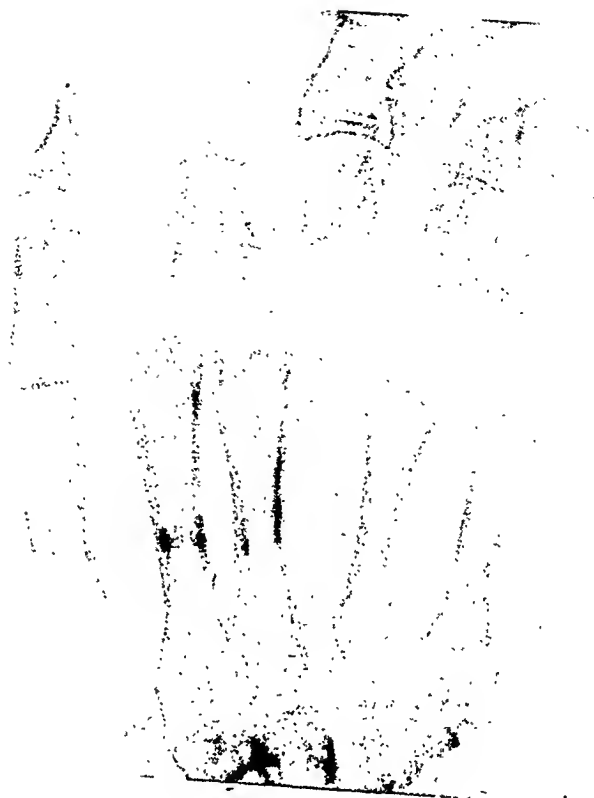
1. 2. 46.



4. 4. 46.

*PLATE V. Case 5.*

1.



2.

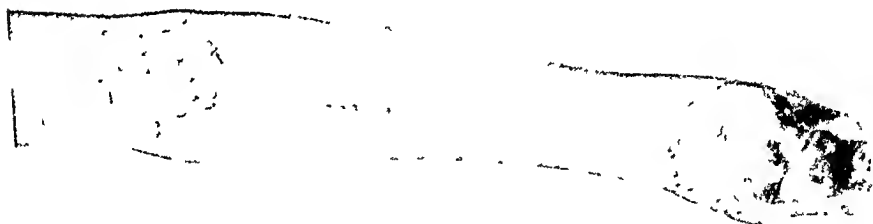
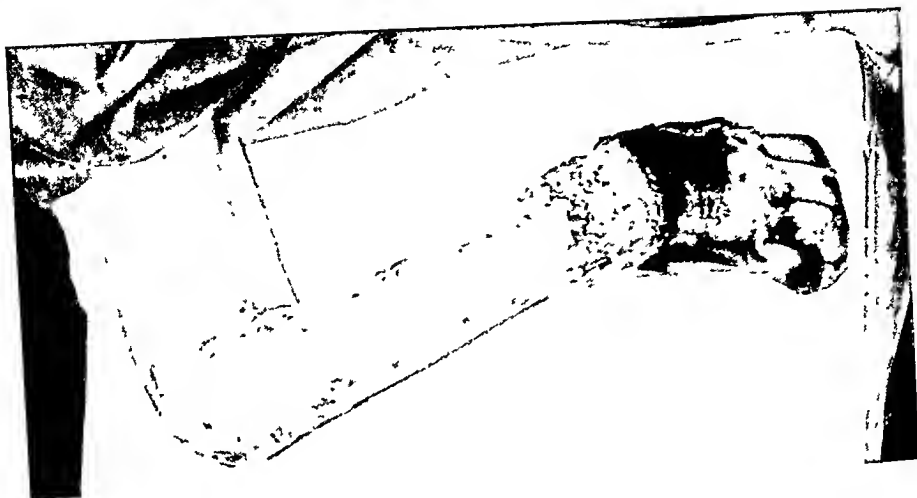


SCHJELDERUP: Skin Avulsion Injuries.



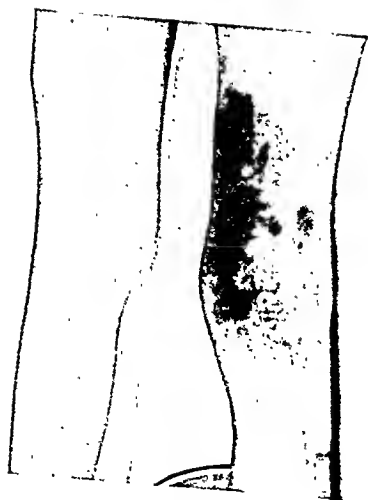
*PLATE VI*

45.



6.9.45.

*PLATE VII.*



20. 5. 46.



20. 7. 46.

*PLATE VIII.*

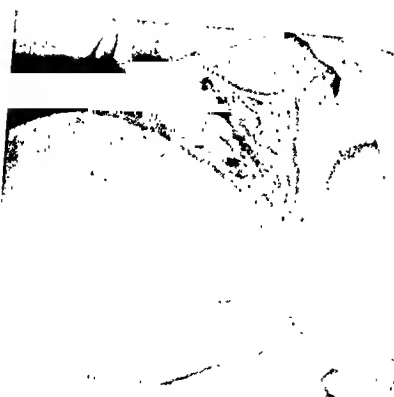


3. 5. 44.



15. 5. 44.

*PLATE IX.*



15. 7. 46.

SCHJELDERUP: Skin Avulsion Injuries.

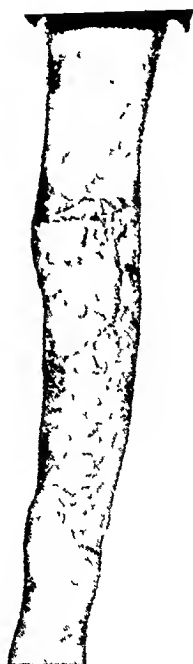
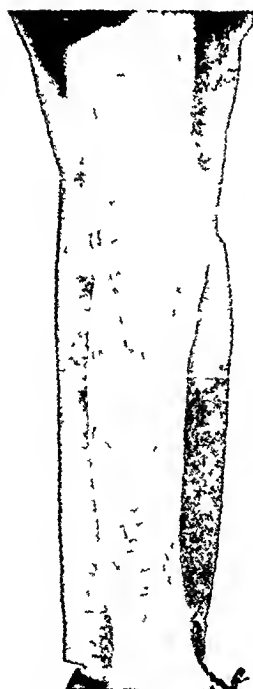
PLATE X.



11.11 46



22.1.47.



22.1.47.

culties encountered by grafting the raw area, due to the old granulations. If the area could have been grafted straight away, the patient might have been discharged from hospital in the middle of January, after just over one month in hospital.

*Case No. 2* is a young man of 19, who, on 24th March 1941, was injured in a traffic accident in London. He was admitted to a hospital with skin loss of antero-lateral aspect of left elbow region about  $20 \times 8$  cm in size. (Unfortunately, no details are available concerning the early treatment.) On 3rd May the patient was admitted to this Unit. The local condition on admission is illustrated in the photograph taken two days later, showing a granulating area surrounded by seared skin. During the following days the wound was cleaned with saline baths and dressings with vaseline gauze and sulphonamide powder.

On the 21st May, all seared skin, including the granulating area, was excised down to fascia and muscle. (Major D. C. BROWN, R. A. M. C.). The resulting raw area was covered with Thiersch grafts. Five days later, when the first dressing was done, it is recorded that the graft had taken completely. Approximately one month later, *i. e.*, on 24th June, the patient was discharged, the graft being stable and the movements of the elbow joint improving under physiotherapy treatment. Photograph from the 6th June shows the healed graft and extent of excision.

In this case it remains unknown whether the skin was avulsed and lost at the accident or if it was replaced and subsequently became gangrenous. This is, however, of minor importance compared with the fact that the patient was in hospital for two months before skin grafting and, following this, was discharged after a month, in a completely healed condition.

*Case No. 3* is a boy aged 15. He was knocked down by a bus on 9th February 1942. About three months later, on 5th May he was admitted to this Unit. For this period his records only state that he had been treated in two other hospitals and that "there was a large laceration of the right leg extending from the knee to the ankle. Contracture has resulted. The patient has not walked since the accident". Condition on admission is clearly recorded in the photograph taken in 9th May. There is  $10^\circ$  loss of full extension of the knee joint.

On 12th May, the entire granulating area, with the surrounding zone of scar tissue, was completely excised, with the exception of a patch over the front of the tibia. The fibrous base was also completely removed. A thin Thiersch graft was sutured into the defect on the outer side of the leg where the base was soft and vascular. Vaseline gauze and sulphonamide dressing to the remaining raw area. (Operation, Mr. J. B. CUTHBERT).

A fortnight later, a thin Thiersch graft was applied to the remaining

raw area and, on the 1st June, it is recorded complete take of grafts and the photograph taken on 17th June (Plate III) shows the healed condition. On 1st July, the patient was allowed out of bed. The graft was well healed and extension of knee joint full. After having been walking about for one week, a small breakdown over the ham-string tendons was recorded. He was discharged on 12th August after one unsuccessful and one partially successful grafting. He was to be re-examined in November the same year but did not attend and one may assume that he was healed in the meantime. The condition on discharge is seen in the photograph taken on 17th August.

In this case there is no information on the treatment the patient received prior to the admission to the Plastic Unit, but one can get an idea of what has been going on. First of all, it is revealed that there was "a large laceration extending from the knee to the ankle". Secondly, one gets the following clues from studying the photographs: the proximal border of skin has a linear, well-defined outline towards the raw area and a series of clearly visible stitch marks. On the other hand, the distal border is irregular and grossly scarred. No stitchmarks are visible here. On these clues one may reconstruct the case as follows: the injury resulted in circular avulsion of the skin of the leg from the knee to the ankle region. At the first operation, the avulsed skin flap was resutured, with subsequent loss of the proximal half of the flap. During the following three months, separation of the dead skin has taken place before commencement of plastic surgical treatment. This is prolonged owing to well known difficulties in free grafting of the popliteal fossa which, however, is a surgical problem of its own and does not justify a detailed description here.

*Case No. 4* is a boy of 15 years who got his left arm caught in a machine while working in a factory, on 23rd January 1946. He was admitted to hospital where the skin was found to be degloved from just above the elbow joint and half-way down the forearm. He could move his fingers which were not ischaemic. Skin edge "fairly healthy two hours after injury". No fracture clinically.

Operation note: (three hours after injury).

"Some skin excised. Several bleeding vessels secured and tied off. Skin edges sutured in position with mattress sutures almost  $\frac{3}{4}$ " intervals for drainage. Raw area treated with penicillin-sulphonamide powder. Vaseline gauze dressing. Pressure-dressing not too tight."

On the two days following, things started to go wrong and the patient was transferred to this Unit. On admission the general condition was found to be poor, the patient being pale (Hgb. 54 %), and complaining of pains in his left arm. The skin on the left arm from 4" above the wrist and upwards was of blue-red colour, with-

out colour return after digital pressure. There was some discharge of thin fluid from the suture line. In some areas there was formation of blisters.

Soon after admission, the patient was taken to the theatre. At the operation (the author) the sutures were removed and the skin was found to be torn off the fascia right down to the wrist joint. The obviously dead portion of the skin was removed, but the distal 3—4" of skin was preserved in spite of being undermined. This was done because of obvious circulation in the skin and freely bleeding arteries from the cut edge. Another determining factor, was the desire to accomplish the operation as quickly as possible. The fascia was cleaned and the entire raw area was covered with skin from the thighs taken with Padgett's dermatome. The raw area is recorded on the photograph taken during the operation. (Plate IV). The patient had two pints of blood given during and after the operation.

At the first dressing on 1st February, complete take of grafts was recorded. The photograph taken the same day shows the pattern of grafts, still with the continuous sutures. During the following month, the patient received physiotherapy to his elbow joint which had become very stiff during the period of treatment. On 3rd April he was discharged and physiotherapy treatment was to be continued at home.

On 15th September, he returned here for review. The grafted area was soft, the graft adequate and he had full range of movements of the elbow joint. Photograph taken on 4th April shows the grafted area well healed and limited flexion of his elbow.

In this case — if admitted directly to a Plastic Surgical Unit — the whole of the avulsed skin could have been transformed into a full thickness free skin graft, "Wolfe graft", and the patient spared the evil effects of gangrene of a large area of skin. He would also have been spared having extensive and painful donor areas on both thighs. On the other hand, it is a good example of free skin graft repair of this type of injury.

*Case No. 5* is also a factory accident, in a boy of 15 years. On the 7th March he got his right hand and arm caught in a bookbinding machine, which stripped off the skin like a glove from the elbow region on to his fingers, where it was all piled up. The skin was stripped clean off the fascia which was intact except for a few minor tears. He was admitted to this Unit an hour after the injury. On admission the general condition was fairly good. X-ray of the injured arm showed loosening of the epiphysis of the olecranon. The epiphysis of the thumb was fractured and so were all the epiphyses of the metacarpals, as can be seen from Plate V. There was considerable diastasis between the fragments due to the avulsed skin piled up on the hand and interposed between the bone ends. There was also a fracture of os multangulum majus with slight displacement.

Two hours after the injury, the patient was operated on (Dr. GRETE OLSEN and the author). The avulsed skin was replaced and a circular incision was made just proximal to the wrist line and the now loose skin tube was turned inside out and all the subcutaneous tissue was carefully removed, thus transforming the entire skin flap into a full thickness free skin graft of the Wolfe type. The proximal skin edge was trimmed and it was found that the skin was detached from the fascia to just above the elbow. It was, however, thought justifiable to leave this skin as a flap. The same decision was made concerning the skin of the hand and fingers although under great doubts. The metacarpal epiphyses were reduced and so was the one of the thumb. The position of the latter had to be secured by a stainless steel wire. A rubber drain was inserted into the palm and a pressure dressing applied to the arm. It was found unwise to apply any plaster of Paris fixation for the fractures of the hand. The position of the latter is shown in Plate V.

From the day after the operation it was obvious that the circulation in the fingers was very poor and slow but, inevitably, gangrene of the fingers and the hand developed.

The skin graft however, took almost completely, while, on the other hand, the undermined portion of skin around the elbow joint sloughed. The condition during this period is seen from the photographs taken on 27th March 1945. On 3rd April, all fingers were amputated through the fracture lines. A week later the remaining raw areas were skin grafted. About the 1st May he was healed. On 8th June he was transferred to another Unit for fitting of a prosthesis. Photograph taken on 6th September shows the healed condition. (Plate VI.)

Considerable knowledge can be gained from this case but, first of all, one may consider this case as a typical example of repair by turning the avulsed skin flap into a full thickness free skin graft of the Wolfe type. The good take of this graft contrasts clearly against the sloughing skin proximally and distally to the graft, and one must admit that the gambling on the survival of the skin on the hand and around the elbow joint was clearly against the principles already described. On the other hand, it would have proved to be a much bigger operation to skin the whole hand and fingers — a trauma to which, at the time, it was not thought justifiable to submit the patient.

It is, of course, very difficult to argue afterwards as to whether the fingers had a chance of surviving or not even if the skin had been removed from the hand in view of the considerable overstretching of nerves and blood vessels. At the accident, the fingers had also been crushed between the rollers of the book-binding machine, this adding to the damage of the subcutaneous tissues. On the whole, one is of the opinion that little could have

been done at this stage to save the fingers but, on principle, one must admit that leaving the skin as it was, is wrong.

*Case No. 6* is a boy aged  $8\frac{3}{4}$ , who, on 27th February 1946, sustained extensive lacerations of left thigh and knee with exposure of knee joint. He was immediately admitted to hospital where wound toilet and repair was carried out. He was admitted to this Unit on 9th May with a large, dirty-looking, granulating area on the anterior aspect of lower left thigh and knee joint, as can be seen from photograph taken on 20th May (Plate VII). Following admission the wound had to be cleaned up and infection checked.

On 20th May he was operated on (Mr. J. M. ROBERTS). The majority of scar tissue and granulations were excised. Ten days later a Thiersch graft was applied to the freshly granulating area. On 12th June some minor raw areas still remain from the previous grafting and these were now covered by Thiersch grafts.

The child was discharged on 22nd July, almost completely healed. He was re-examined on 1st October. The leg was now completely healed and he had full range of movements of the knee joint.

Unfortunately, we have no information of the treatment at the first admission after the accident, apart from "wound toilet and repair", but it may well happen that the "repair" means sewing back of an avulsed flap. For all these months, however, this patient was left untreated with a large granulating area over the thigh and knee joint. One may be in no doubt that if this wound had been left to heal entirely on its own the patient would have ended up with a stiff knee joint. One may also emphasize the importance of getting the wound healed straight away, as the knee joint was opened at the time of injury and leaving it open means a very substantial danger of infection of the joint.

*Case No. 7* is a boy of  $6\frac{1}{2}$  years who, on 14th April 1944, had been run over by a bus. Skin had been ripped off the entire buttock, the tear extending into the anus. The wound was dirty. At the operation in the hospital where he had been admitted, wound toilet was carried out and the large buttock flap was sutured into place. The flap did not take, however, and it was then realised that extensive skin grafting would be required. He was, therefore, admitted to this Unit on 2nd May, eighteen days after the injury. On admission was found a large granulating area over the left buttock, extending on to the right and outer side of the left thigh. The condition on admission is revealed in photograph taken on 3rd May (Plate VIII).

At operation (Major Fitzgibbon, R. A. M. C.) on 11th May, the raw area was covered with "postage-stamp grafts" (Thiersch). At the first dressing, four days later, all the grafts had taken well, as can be seen from photographs taken on that day. (Plate VIII.) On 22nd May, the remaining raw areas were grafted but, owing to the tremendous



inflow of battle casualties from the invasion of France, the child was discharged without being quite healed. (6. 7. 44.)

This case is another example of the sloughing of an avulsed skin flap sewn back into original position. But, as the disaster became evident, the surgeon realised the necessity of extensive skin grafting, whereupon the patient was transferred to a Plastic Unit. The difficulties in getting the skin grafts to take were probably due to the very fibrous base of the granulations. The patient will be admitted later for further treatment and it may prove necessary to do a flap repair of some sort.

*Case No. 8* is a boy, 9 years old, who, on 22nd June 1946, was run over by an unloaded two-ton lorry, a wheel passing over his left thigh and pelvis. He was immediately admitted to hospital where the following injuries were recorded: extensive lacerations running one inch from the anus posteriorly across the buttock and half-way down the thigh laying bare the gluteal muscles and communicating with a fracture of the ischium. The child was in considerable shock and complained of abdominal pains. No signs of intra-abdominal lesions could, however, be found. During the following  $1\frac{1}{2}$  hours,  $2\frac{1}{2}$  pints of blood was given intravenously.

At operation the wound was excised; much grass and road grit was removed and the wound closed.

Post-operatively, a massive collapse of the right lung developed but was clearing up on 27th June, when the following note was made: "Large area at apex of flap has undergone necrosis. 15 sutures removed". On 2nd July: "Wound healed except for a large area of skin which is gangrenous and has a line of demarkation but this is clean and dry". On 12th July: "Wound dry. Area below gangrenous skin clean. Fit for transfer to Plastic Unit for skin grafting and treatment of fractured pelvis".

The patient was admitted to this Unit on 13th July. On admission the general condition was found to be good. There was a large area of skin necrosis on the posteromedial aspect of the left thigh. It was dry and crusted. Nearly full range of movement in both legs. No complaints of pain. Chest clear. Condition on admission can be seen on photograph on Plate IX.

On 15th July he was operated on (Mr. J. M. ROBERTS). All the necrotic skin and subcutaneous tissue was removed down to muscle. The remaining surface was not thought fit to receive a graft and consequently left to granulate.

On 31st July the raw area was covered with a Thiersch graft and five days later the patient was transferred to the orthopaedic ward for treatment of the fractured pelvis.

This case also clearly demonstrates the necrosis of an avulsed skin flap sewn back into its original position and, in this particular

case, the treatment of the fractured pelvis was delayed for more than a month.

The patient has, however, been very fortunate in having avoided an infection of the necrotic skin. One may remember that it was a dry necrosis and it was kept dry all the time previous to the admission for plastic treatment, an amazing fact considering the close relation to the anal region. From his history, one may also remember that the laceration communicated with the fracture of the pelvis, and it may not be considered doubtful that infection of the whole area might easily have spread to the fracture and caused an acute osteomyelitis, which, in a child of this age and poor general condition, would have proved fatal.

*Case No. 9* is a 21-year-old woman serving in the W. R. N. S. On 25th September 1943, she was knocked down by a lorry and lost consciousness for a few minutes. She sustained slight injury to the head and severe injuries to the left leg. A large area of skin had been avulsed from left thigh and leg. She was immediately admitted to hospital where the avulsed skin flap was replaced.

On 10th October she was transferred to a Royal Naval Hospital where it was found that the skin flap had not taken and that the greater part of it was gangrenous. This was removed and Eusol packs applied for 20 days. The leg was then dressed with streptocide powder and put into plaster until 26. 10. 43. She has been afebrile since 10th October and had no pains in the leg.

On 11th November she was transferred to this Unit for plastic surgical repair. On removal of the plaster the granulating area was found to be fairly clean. During the five following days the granulations were cleaned and prepared for grafting.

On 16th November, the entire raw area was covered by thin Thiersch grafts (Mr. J. B. CUTHBERT). The grafts took quite well and, on 30th November, Thiersch grafts were applied to the remaining raw areas on back of leg. A fortnight later the patient left the hospital but was not quite healed.

On 4th January she was still not quite healed, but the large areas of grafting appeared stable. There was still some oedema of the foot. No further operative treatment was considered to be indicated at this stage. Simple dressings until healed were recommended and a bandage on the leg to be applied in the mornings.

The patient attended here on 7th November 1946 for examination. The grafts were well healed and appeared stable and supple. Movements of knee joint, free and full. Power normal. No oedema of leg or foot. The patient explains that she has had no trouble with her leg and six weeks after her discharge from hospital she returned to duty and eight months later she was serving abroad in the Navy.

The story of this patient is largely the same as in the previous cases, with the initial delay by sewing back the avulsed skin and delay in getting the grafts to take on old granulations. This, however, proved to be of minor importance in this case as only small raw areas remained, causing no serious troubles to the patient and finally healing up on their own, with a perfect ultimate result, especially as regards function.

*Case No. 10* is that of a 21-year-old corporal in the R. A. F. On 3rd October 1946 he was involved in a motor accident and sustained lacerations of right leg. Immediately after injury he was admitted to hospital. No bony injuries could be found. Toilet of wound. Much gravel in all layers. Skin had been stripped off deep fascia just above the knee joint down to about 4" above the ankle. The muscle layers were exposed on the medial side. Much gravel removed from the soleus muscle. Skin edges excised and skin replaced. Leg enclosed in plaster.

On 24th October, the patient was transferred to this Unit. On admission, a large granulating, dirty-looking, area was found on posterior aspect of right leg from knee almost to ankle. Over anterior aspect a gangrenous flap of skin. The general condition was fairly good. The following day he was operated on (the author) and the whole of the gangrenous skin was removed. It stripped off the underlying granulating tissue without any effort. The fascia was torn on the medial aspect of the leg laying the muscles bare. In the middle of the raw area the tibia was denuded for about 3". The base was considered quite unsuitable for taking a graft at this stage and was, therefore, left for cleaning up under saline bath treatment.

A week later the wound was clean and was covered with thin Thiersch grafts. At the first dressing the grafts had taken completely and, on 11th November, Thiersch grafts were applied to the remaining raw areas in between the previous grafts. At the same time, a series of holes were drilled through the cortex of the exposed tibia to try to get the bone covered by granulations for subsequent grafting.

On 29th November, the whole of the previously denuded bone was covered by healthy-looking granulations and a Thiersch graft was applied. Otherwise, the leg was almost healed by now. In the middle of January, the leg had completely healed. He stayed in hospital to the end of the month for walking exercises and was recommended for a couple of weeks' leave before return to duty.

Again the same old story of the avulsed skin being replaced with subsequent sloughing but, concerning the treatment, a new point is illustrated by this case. As previously mentioned, part of the anterior surface of the tibia was denuded and no free graft could be expected to take on bare bone. The first plan was to get the rest of the leg healed as quickly as possible. This was substantially achieved within a fortnight, only leaving insignificant

spots. For the denuded bone, however, two ways of treatment offered themselves: either covering by a cross leg flap from the opposite calf or getting it covered by granulating tissue suitable for taking a free graft. In the present case one chose the latter way as being the easiest and, if successful, by far the quickest of the two. After eighteen days, the bone was covered by granulations suitable for taking a graft and the skin graft applied to the area took almost completely, thus saving the patient from the more elaborate procedure of a cross-leg flap. The photograph taken on 11th November shows the denuded tibia surrounded by grafted areas almost healed. The pictures taken on 22nd January shows the healed condition.

### Summary.

The mechanisms causing avulsion of the skin are described. The causes of necrosis of the avulsed skin flap are discussed, being ultimately causes of circulatory disturbances. The pathological development and way of healing taking place in untreated cases is described; the final result being either a skin surface covered by thin scar epithelium liable to constant breaking down, or the case is complicated by joint contractures due to shrinking scar tissue. These disabilities may also occur combined. It is emphasized that the treatment must aim at restoring skin continuity as quickly as possible to prevent formation of massive scar tissue with subsequent shrinking resulting in contractures of neighbouring joints and also to prevent infection from the raw area. *Replacement of the avulsed skin as a whole thickness skin flap should be abolished altogether, owing to the high percentage of failure by necrosis of the skin.* Two methods for skin replacement are mentioned: a) the avulsed skin is converted into a free skin graft of the Wolfe type, b) the avulsed skin is discarded and the raw area is covered by free skin grafts from somewhere else. Exposed bone or tendons must be covered either by local tissue before skin grafting or by full thickness pedicle graft. Principles for treatment of previously untreated cases are given. Joint contractures offer absolute indication for plastic repair whilst unstable scarring offers a relative indication. Case records with individual comments.

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From the County Hospital of Ystad.  
(Surgeon-in-Chief: E. BIÖRKLUND.)

## On the Treatment of Hirschsprung's Disease with Report of an Operated Case (extraperitoneal Resection of the Megasigmoid in one Stage).

By

ERIC ARENANDER.

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Ever since HIRSCHSPRUNG's description in 1886 of the disease named after him, there have been many different theories concerning its origin. It has been considered that the disease was a congenital malformation or that it was caused by a mechanical obstruction, principally on the junction between the pelvic colon and rectum. In our day the general opinion is that the disease has a neurogenic origin, namely a disturbance in the relationship between the sympathetic and the parasympathetic innervation of especially the distal portion of the colon, with predominance of the sympathetic influence. It is not the intention of the author to further deal with the pathogenesis of HIRSCHSPRUNG's disease, this has recently been discussed by EHRENPREIS in *Acta Chirurgica Scandinavica* 1946: 94: suppl. 112.

EHRENPREIS studied a material of ten cases of megacolon in the newborn, thereby finding that the disease commonly debuted with an ileus condition, which clinically and roentgenologically could not be distinguished from meconium retention. The further course was decisive. The megacolon cases showed already in the initial stage of the disease a poor emptying power of the colon. Roentgenologically colon showed no other deviations from the normal. No mechanical obstruction was demonstrable. The colon dilatation developed *secondarily*. On this basis EHRENPREIS defines the megacolon disease as "a dysfunction of the evacuation of the colon of an as yet unknown origin occurring in the absence of morphological or mechanical causations and giving rise secondarily to a characteristic dilatation of the colon".

*Treatment* of megacolon is partly medical (conservative), partly surgical.

Medical treatment comprises inter alia a hygienic-dietary regimen, enemata, intestinal lavage, bougie treatment (HURST). The commonly used laxatives have no effect. Liquid paraffin, however, is of some value. Good results have been achieved with pharmaceutics, influencing the autonomic nervous system (acetyl-beta-methyleholine, syntropan, gyncergen, doryl etc.).

As regards surgical treatment a great number of various operations have been utilized. The older methods: colopexia, coloplication, anastomoses, anus praeternaturalis etc., have since long been relinquished. The measures considered at present are resection and neurosurgical procedures (various sympathectomies). Resection has been performed in one or several stages. Various methods have been followed, such as exteriorization of the bowel according to MIKULICZ or invagination resection according to GREKOW-KÜMMELL (the latter method of course only applicable on localization to the distal portion of colon). Total colectomy has also been done, usually with ileosigmoidostomy or ileorectostomy, if the distal portion of sigmoid or rectum is not affected. The neurosurgical treatment was initiated in 1927 by the Australian surgeons WADE and ROYLE. A great number of different methods have since then been tried and utilized with certain modifications, dependent on the location of the disease to different portions of the colon, thus:

Ramicotomy (WADE & ROYLE); resection of the superior hypogastric plexus (presacral nerve) and inferior mesenteric plexus according to RANKIN & LEARMONTH; resection of the lumbar ganglions + possibly superior hypogastric plexus (ADSON), and subdiaphragmatic splanchnic resection according to ADSON and LERICHE.

PÄSSLER subdivides idiopathic megacolon into three groups, corresponding to the sympathetic innervation:

- 1) proximal portion of colon (superior mesenteric plexus),
- 2) descendens and the sigmoid (inferior mesenteric plexus),
- 3) rectum (superior hypogastric plexus).

Megarectum is always associated with megacystis.

Resection of the superior hypogastric plexus in males occasions disturbances of ejaculation.

On seeking, through the extensive megacolon literature, to form an opinion of the *results* of the various methods of treatment, one finds rather contradictory reports. Megacolon is a rare disease and therefore most authors have but few own cases.

In addition many of the published cases have only been observed for a short time.

Medical (conservative) therapy gave according to earlier abstracts very poor results. Of NEUGEBAUER's (1913) compilation of 254 cases from the literature 136 were treated conservatively with an immediate mortality of 68 per cent and with good results only in 6.6 per cent. JUDD & THOMPSON (1928) had 81 per cent improved and 19 per cent deaths in conservative treatment. Of ASK-UPMARK's 102 cases from Swedish hospitals 54 cases were treated conservatively with a primary mortality of 22 per cent. Late results: 75 per cent cured or improved, 15 per cent not improved or deteriorated, 10 per cent dead. If also those patients which first in vain were treated conservatively and later operated were included as not improved, the figures were instead 59 per cent, 35 per cent, and 6 per cent, respectively. — At present we may calculate with considerably lower figures. Treatment with pharmaceutics acting on the autonomic nervous system has surely been contributory to this (LAW and others). Of GRIMSON, VANDEGRIFT & DRATZ' 24 megacolon cases at Duke Clinic the majority were treated conservatively with gratifying results. It is of interest to note that HURST, who has a large number of own cases, considers that the majority of the cases may be managed with a solely conservative therapy. He also considers as beneficial the utilization of a conical bougie, which is introduced into the anus (for treatment of the "achalasia" of m. sphincter ani).

The surgical treatment gave according to NEUGEBAUER (1913) far better results than the conservative therapy, thus particularly resections. Of 43 resections 23 were operated in one stage with a mortality of 26 per cent, and 20 were operated in several stages with an operative mortality of but 5 per cent. JUDD & THOMPSON (Mayo-clinic 1928) calculate with good results from surgical intervention in 61 per cent of the cases, with an immediate mortality of 23.3 per cent. In ASK-UPMARK's material from Swedish hospitals (1895—1928) 48 cases were operated with a primary mortality of 40 per cent (21 cases with resection in one stage, 10 cases in several stages, 17 cases with anastomoses, and 5 cases with other forms of palliative intervention). The late results (after observation of from one to twenty-five years) were 72 per cent cured or improved, 7 per cent not improved or deteriorated, and 21 per cent dead. ANSCHÜTZ 1931 reports 20 cases (the majority megasigmoid) which were operated according to MIKULIČ, in 15



eases with recovery, 1 case poor results, 2 post-operative deaths, no late deaths, in 2 cases the late course was not known. Thus, out of 16 operated cases which were followed up there were good results in 15 cases and only one failure. ANSCHÜTZ allows an interval of some time — several months — to elapse before he closes the anus praeternaturalis instituted at the first stage, as means of relieving the bowel. Other authors, however, have not had as good results as ANSCHÜTZ. — Total colectomy (in one or several stages) has also been advocated. JUNGHANN in 1943 surveyed 18 cases from the literature, of which 7 had died (39 per cent mortality). With the recent medical progress in regards to pre-operative and post-operative treatment, chemotherapy, anesthesia etc., the mortality has undoubtedly been lowered appreciably, although no large follow-up series concerning this fact have as yet been published.

YEAZELL & BELL (1943) have 6 cases, all living, with resection of the affected segments of the colon; the results are in 5 cases good, in 1 case less satisfactory (total colectomy). — GRIMSON, VANDEGRIFT & DRATZ (1945) report 3 operated cases with subtotal resection in one stage and ileosigmoidostomy. The results were favourable in all of the cases, the patients tolerating the extensive procedure well, but having, however, several loose bowel movements daily. In earlier literature the disease was reported as being usually located to the sigmoid exclusively. With X-ray etc. these authors consider themselves to have established that this but rarely is the case. (Sub)total colectomy ought accordingly to be the method of choice.

After WADE & ROYLE's introduction of the sympathicus intervention in megacolon many enthusiastic reports of the good results of this procedure were published in the literature of the thirties. Reviews of the literature by PÄSSLER 1938 and later RIEDER & BLUM 1944 reveal that out of 180 cases 38.8 per cent were classified as cured, 49.4 per cent as improved, and 10 per cent as not improved. The mortality was not more than 1.7 per cent, thus definitely the best statistics. The period of follow-up observation, however, was in the majority of the cases very short, and subsequently quite a few studies have been published which seem to indicate that the results of this treatment have in the long run not fulfilled the optimistic first expectations (JUNGHANN; YEAZELL & BELL; GRIMSON, VANDEGRIFT & DRATZ; MICHAËL; SANDBERG; WALDE, and others).

When the origin of the disease is held to be neurogenic it is evident that some form of neurosurgical intervention should come into consideration. As there as yet is a certain lack of clarity in regards to the autonomous innervation of the bowel it is possible that an improved operative technic and clearer indications may be attained in the future. It may finally be mentioned that a number of authors recommend both resection and sympathectomy in the same case (INTROZZI and others).

The author will not deny the value of a sympathectomy, especially in those cases which react favourably to spinal anesthesia and sympathetic block. Several authors consider that they have reached satisfactory results with these measures alone (STABINS, MORTON & SCOTT, HAWKSLEY, PLICHET, and others). Colon- and cystometrography are also of value as pre-operative function tests.

The resection is intended to remove the diseased portion of the bowel. It should be considered justifiable at least in those cases in which owing to the marked dilatation a more or less pronounced mechanical obstruction to passage has arisen (kink formations etc.), and where there is danger of volvulus etc. In many cases of partial resection there have been late recurrences which have been considered due to the fact that an insufficient portion of the diseased bowel has been removed. It must be considered unlikely that the already existent anatomical changes in the bowel may be appreciably influenced by sympathectomy. The anatomy, however, is non-essential, the important factor naturally being the functional clinical result.

The author wishes to report a case of idiopathic megacolon, treated with resection of the enlarged sigmoid. As the technique is somewhat divergent from that usually followed it will be described. The method is also of value in other diseases than megacolon.

J. N:o 571/46, L. A., female, thirteen years of age, admitted to the County Hospital of Ystad  $\frac{3}{4}$  1946.

*Past History.* The patient has since early childhood had sluggish bowel movements. Has not been hospitalized nor sought advice for this. The last satisfactory bowel movement 14 days prior to admission. One week ago the patient took castor-oil, after which a small loose movement ensued. She has been tired and languid for the last week, and has since the last couple of days felt sick and has vomited. No pain.

*Present status*  $\frac{3}{4}$  1946: General condition somewhat deteriorated.

Facies pale. Heart and lungs normal. Abdomen: meteoristic, distended, non-tender. Per rectum 0.

X-ray, abdominal scout-film 3/5: Large amounts of feces, for the rest nothing definite.

X-ray, contrast enema 3/6 (Fig. 1 and 2): *Megasigmoid*, the remainder of colon fairly normal.

Following intestinal lavage-prostigmine etc. large amounts of feces were passed (nearly 10 kg). Pre-operative treatment with sulfadigesin Astra.

Operation 3/15 1946 (WOOREMAA). *Resectio coli sigmoidei*. Ether anesthesia. Midline incision below umbilicus to, although not through peritoneum, which is freed by blunt dissection at least 5 cm on either side. After this peritoneum is opened in the midline. The X-ray findings are corroborated. A megasigmoid with markedly hypertrophic musculature but no haustrations is present. For the rest, colon is normal, no megarectum. The dilated portion of the bowel is delivered through the wound and mesosigmoid separated from the bowel. Peritoneum parietale is sutured to both ends of the sigmoid loop, and the base of the mesosigmoid is approximated to peritoneum with a couple of sutures. The sigmoid which now is situated extraperitoneally is resected as usual, side-to-side anastomosis colon descendens—colon pelvinum. The anastomosis is nearly covered by the mesosigmoid which is turned back like a cuff and sutured over it. The protruding portion of the bowel is then inverted and the abdominal incision closed with sutures of the anterior rectus sheath and the skin. Tamponade in the lower angle of the incision.

Post-operative course very favourable. No fever. Normal bowel movements since the 8th post-operative day. Discharge 14 days following operation. Operative wound healed.

*Follow-up examinations:*

9/14 1946 (after 6 months): The patient has been well all the time and has had a daily normal movement.

X-ray contrast-enema shows a colon of fairly normal configuration, normal emptying power (Fig. 3 and 4).

1/13 1947. X-ray barium meal: Esophagus of normal width. Stomach and duodenum normal. After 7 hours most of the meal is in cecum and colon ascendens, after 24 hours it has reached the distal portion of colon.

1/17 1947. Intravenous urography shows normal conditions. — No megacystis. Bladder capacity 300 cc.

3/21 1947 (after appr. one year): X-ray barium enema shows no essential changes since 9/14 1946.

With the operative technique described above the anastomosis will thus be extraperitonealized. Additional provision is gained by turning the mesosigmoid like a cuff over the anastomosis and suturing over this, according to WOOREMAA. The mesosigmoid may possibly be somewhat divided so that it suffices for this, if

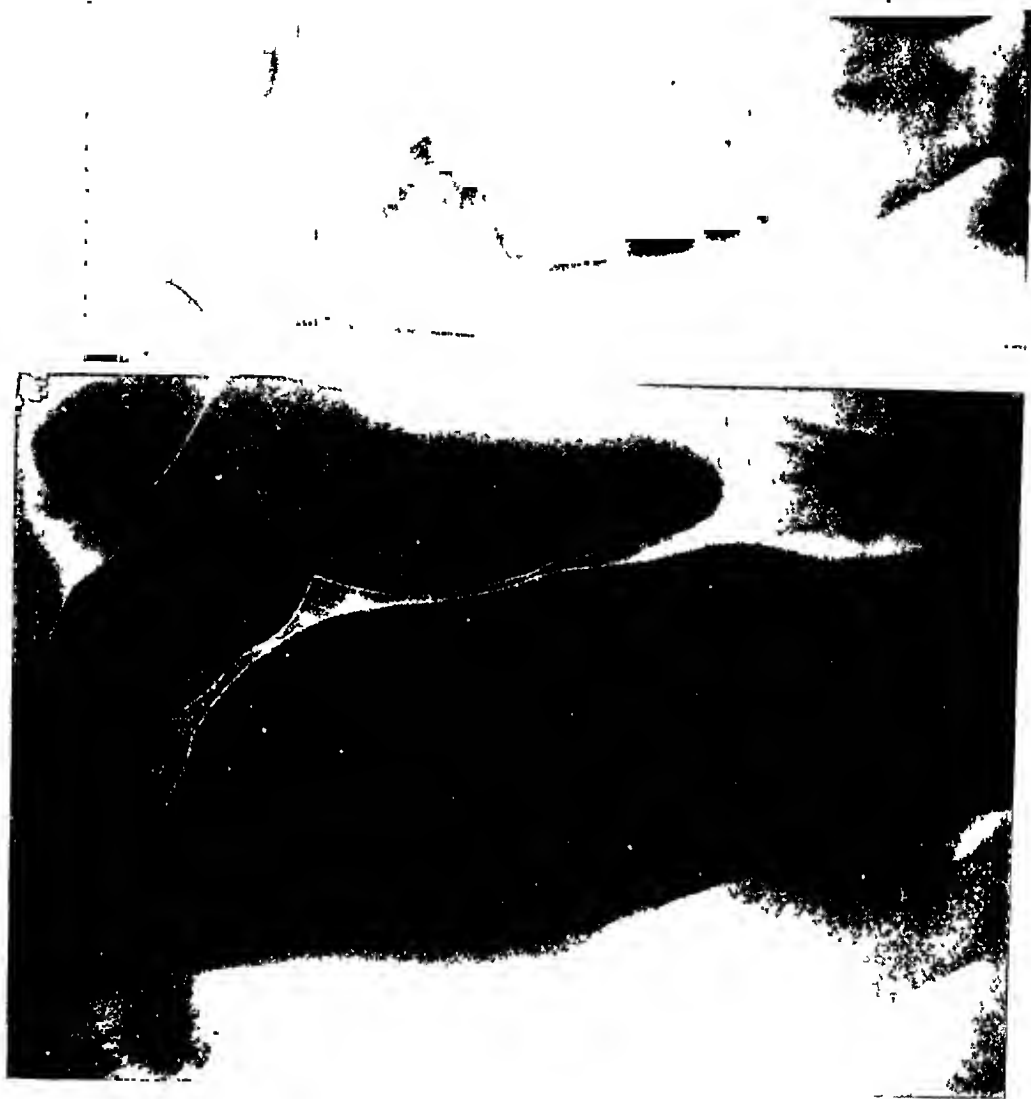


Fig. 1 and 2. Barium enema prior to operation.

ARENANDER: Treatment of Hirschsprung's Disease.

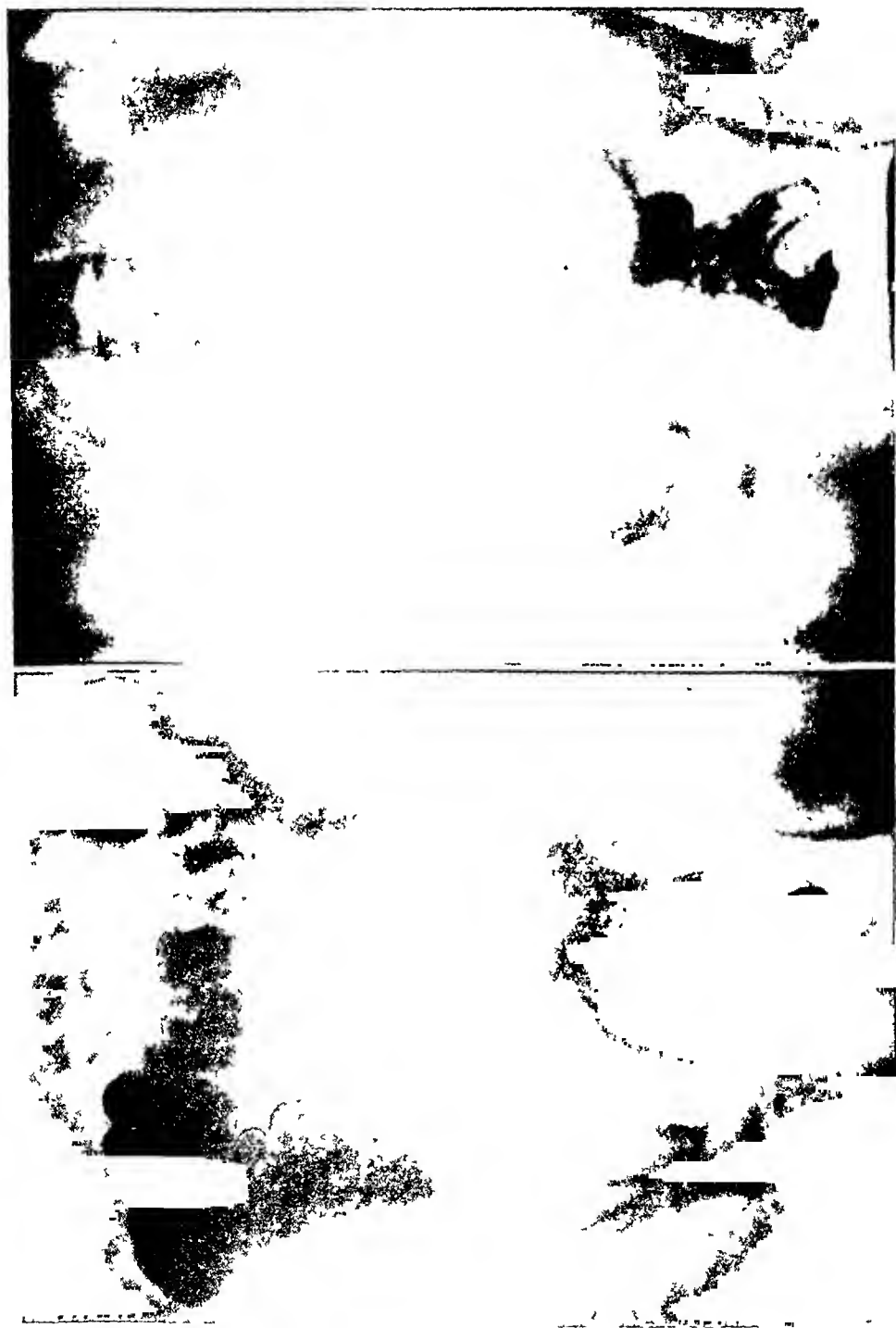


Fig. 3 and 4. (6 months after operation) Contrast enema. Emptying-film. — One year after operation approximately the same picture as Fig. 3 and 4.

care is taken not to injure any larger vessels. It may possibly be a matter of taste whether the anastomosis is performed end-to-end, end-to-side, or side-to-side. In the present case it was done side-to-side, as it often is difficult to approximate the stumps which have different lumens, without tension. The utmost possible of the sigmoid should be removed distally, in order to avoid kinking of the junction to rectum. The greatest difficulty is suture insufficiency and death in peritonitis. With this technique, however, there will not be any diffuse peritonitis, even if in spite of all measures taken to the contrary the sutures do not hold, as the peritoneum then already will have healed up, and the anastomosis is extraperitoneal. There will in this case be an anus praeternaturalis (which subsequently will be closed) or an abscess will appear in the operative wound.

*Post-operative treatment* is of great importance. It is imperative to prevent the accumulation of large amounts of feces in the bowel, these do not necessarily give any subjective symptoms, at least in the beginning, wherefore regular X-ray check-up examinations are necessary.

Another case operated upon by the same surgeon is described by H. KUMPAS in *Eesti Arst* 1941: 20: 24. The case was that of a fourteen-year-old boy, who for many years had had difficulties in the form of obstipation and abdominal distension. The patient was 2/3 1938 admitted to the II Surgical University Clinic of Tartu, where he was operated on 2/15 1938. The segments affected were the left portion of the transverse colon, colon descendens and the sigmoid, with the exception of the last 5 cm distally. Colon descendens had a 3 cm long mesentery, mesosigmoid and mesocolon transversum were considerably longer than is normal. The operation was performed according to the methodics described above. The post-operative course was also favourable. At the last follow-up examination 8/7 1944 — *six-and-one-half years* after operation — the patient was subjectively in good health, and had a daily, rather loose stool, although he was rather meteoristic. Further reports from the patient have not been available.

### Summary.

After a brief survey of the results attained by various methods of treatment of megacolon the author presents a case operated with resection of the megasigmoid with favourable outcome. The technique is somewhat divergent from that usually described. Midline incision below the umbilicus to but not through the

peritoneum which is freed by blunt dissection at least 5 cm on either side and then opened in the midline. The dilated portion of the bowel (in this case the sigmoid) is delivered through the wound. Mesosigmoid is separated from the bowel. The parietal peritoneum is sutured to both ends of the sigmoid loop. The base of the mesosigmoid is also approximated with a couple of sutures to peritoneum. The dilated portion of the bowel is now *extraperitonealized* and the resection is then carried out according to the routine procedure. Additional security is ensured if the mesosigmoid is turned back and sutured over the anastomosis as a cuff, according to WOOREMAA. The operative wound is closed, tamponade or rubber drain instituted in the lower angle of the wound. Post-operative treatment is of great importance, as well as regular X-ray check-up examinations.

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## Experimental and Clinical Observations on Granulomas Caused by Talc and Some Other Substances.

By

ARNO SAXÉN and P. I. TUOVINEN.

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During the last years the question of so-called talc tumors has a gain come to the front. In the American year-book of general surgery by GRAHAM this problem is dealt with both in 1944 and 1945. In the latter year-book are two cases of ACEVEDO and MERADOS described in which the changes caused by talc granulomas resembled macroscopically tuberculous peritonitis. The authors warned operators against seeding the operative field with talc from surgical gloves. The large investigation of SEELIG, VERDA and KIDD (1943), of which a short account was given in the year-book of 1944, treats the matter experimentally. The occurrence of powdery foreign bodies in the tissue has already several times been investigated. ANTOPOL's (1933) observations on changes in the tissue produced by Lycopodium powder have directed attention also to changes caused by other substances. MARTIN (1881) and MUSCATELLO (1895) proved experimentally Lycopodium powder to cause intraperitoneal changes, but later also the effect of other powdery foreign bodies has been studied. Talc has mostly been discussed. It has been injected intraperitoneally, intrapleurally, intracardially and subcutaneously in animals. ROTH (1923) dealt first with post-operative complications arising from dusting powders. The powder was Lycopodium powder used in a glove.

Simultaneously with the establishing of talc causing the rise of granulomas SEELIG, VERDA and KIDD tried to find another



powder which, absorbed by the tissue, would disappear and cause no changes, and substitute talc in practice. The substitute powder would have to withstand sterilization. For this purpose they studied 24 different powders. The study of these aimed at determining primarily whether or not the various powders possessed such properties as to permit the gloves to come out of the autoclave unchanged. Many of the powders met the test successfully because most of them were sufficiently insoluble. In the starches, however, they established gelatinization which rendered the gloves unusable.

When a physically satisfactory powder was found it was further tested by injecting it as a watery suspension into the peritoneal cavity of white rats. After the injections at intervals varying from five minutes to twenty-four weeks the condition was followed when, in autopsies, pathological lesions were studied both macroscopically and microscopically.

Based on their experiments SEELIG, VERDA and KIDD were of the opinion that talc — magnesium silicate — was under all circumstances a serious menace in surgery. Having once entered the animal organism this powder produces a reactionary, productive inflammation that is permanent and progressive and that may provoke insuperable complications. Postoperatively talc was demonstrated in the abdominal viscera in 80 per cent of examined cases. In their opinion even meticulous care in washing off the surface of rubber gloves before operating does not prevent the operative field from being contaminated by talc. The difficulty in substituting talc lies in the fact that an insoluble powder like talc causes the rise of granulomas, whereas a soluble powder dissolves during the process of sterilization, rendering the gloves adherent and thus difficult to put on. They found that potassium bitartrate met the physical requirements. The tissue and the fluids were not injured by it. It causes no peritoneal adhesions. In their report they recommend it as a substitute for talc. There is, however, one disadvantage, viz. potassium bitartrate tends to shorten the life of rubber gloves. Tartrated gloves would stand from seven to ten sterilizations, whereas talced gloves permitted from twelve to twenty sterilizations.

It has been estimated in America that the fingertip of a carelessly prepared glove contains as much as 100 mg of talc. According to WEED and GROVES (1942) the glove is torn in 74.4 per cent of all operations. During a period of twenty months they examined

gloves and the number of examined gloves was 35,763. In a series of 50 patients GERMAN (1943) found in 40 patients intra-peritoneal talc that had been deposited accidentally during a previous laparotomy. In 42 patients one previous laparotomy, in seven patients two, and in one patient five previous laparotomies had been performed. The talc had entered the abdominal cavity either from the surface or through accidental perforations of the gloves or from gauze sponges contaminated with talc.

There are in literature also reports of changes in tissues effected by sulfonamide. So SUTTON (1942) reports a case of perforative appendicitis, in which the use of sulfathiazole was followed by peritoneal adhesions with obstruction. Besides in this case the wound healed with a keloid scar as a consequence of the use of sulfathiazole.

Based on the above reports, principally American, we have considered it well founded to investigate the occurrence of talc granulomas and the use of talc powder. Sufficient reason for this is also furnished by the fact that granulomas indicating changes caused by talc or some powderous foreign body containing talc, have been established in some clinical cases.

### Animal Experiments.

The occurrence of talc tumors as described in literature and the clinical cases which will be described below, gave us the idea to investigate the origin and character of the granuloma by means of experiments on animals. In our experiments we have besides pure talc also used wound powders containing talc. Sulfonamide dusting powder containing talc is sometimes used in Finland in treatment of surgical diseases, and it has been applied in open wounds both in laparotomies and other operations. This gives rise to the development of granulomas which in the peritoneal cavity may cause intestinal obstructions as appears from literature and from some of our clinical cases. In our experiments on animals we also used for the sake of comparison pure sulfonamide powder into which no other substance had been mixed.

The powders used in our experiments were:

- 1) talc

2) streptolysin wound powder (Orion) containing 35 per cent talc. It is compounded of:

p-aminosulfonamide.....	25.0
urea .....	5.0
amylum .....	35.0
talcum .....	35.0
	<hr/>
	100.0

3) antistrept wound powder (Medica), the percentage of talc of which is 33. It is compounded of:

sulfanilamide .....	25.0
carbamide .....	2.0
amylum .....	40.0
talcum .....	33.0
	<hr/>
	100.0

4) streptolysin powder (Orion), p-aminosulfonamide.

As experiment animals white rats were used. Operations were performed aseptically.

A *laparotomy incision* was made along the median line into the center of the abdominal cavity. When the peritoneal cavity was opened the powder was strewed in between the loops of intestine, sometimes in the region of the small intestine, at other times around the large intestine and often among the coils of the whole intestine. Powder was generally richly introduced, by knife's points. In the first experiments no lesions were made, in later experiments, however, the intestine was pinched with Péan's pincers or tweezers. When the powder had been distributed between the loops of the intestine the laparotomy wound was closed in one layer, generally with catgut.

A *muscle incision* was generally made into the medial side of the right thigh, often also into the abdominal layers. In later experiments the muscle was pinched either with Péan's pincers or with a pair of tweezers, and the powder was carefully introduced into the muscular tissue. The incision was thereafter closed in one layer, generally with catgut. In some cases the talc powder was introduced into the muscle by means of a Record syringe with a thick needle.

There were 30 experiment animals. One of them died of bronchopneumonia three days after the operation as ascertained at autopsy, and two others also died three days after the operation

when the stitches gave way and the intestine prolapsed out of the abdominal cavity.

The operation was made under ether anesthesia. The rats generally sustained the operation well recovering rapidly. The incisions generally healed by the first intention except in a few cases in which wound necrosis or abscesses occurred.

The rats were killed by inhalation of chloroform. Autopsy was performed immediately after the killing and the samples were placed in formalin. Staining with hematoxylin-van Gieson or hematoxylin-eosin.

Observation of the experiment animals were made after periods of various length. The shortest period was 3 days, the longest being 8 weeks.

### Observations of the Animal Experiments.

In the following we shall give a survey of the principal observations made during our experiments with rats, and established at autopsy. A more detailed report will be given of some typical cases only.

We established in the first place that *pure sulfapowders containing no talc did not evoke any foreign body response of the tissue*. The powder dissolved rapidly and was resorbed. When there was no infection (infection occurred in some cases) the operative field was completely healed. On the other hand it was established that talc and powders containing talc produced the same reaction, and that under similar circumstances the reaction would fail to occur. *It was obvious that in streptolysin and antistrept wound powder the irritant substance impairing the tissue was talc*.

Which are thus the circumstances under which tissue changes with characteristic granulomas, caused by talc powder, develop? The first condition is that a large quantity of powder has entered the tissue.

Sometimes, however, no permanent changes occurred, or the changes were quite unimportant although a large quantity of talc or of powders containing talc had entered the tissue. The changes were as a rule unimportant or they disappeared totally two or three weeks after the injection, or after the powder was strewed into the peritoneal cavity or between muscle bundles or fibers, separated bluntly with scissors without intentionally injuring the tissue to any great degree. The formation of new tissue

caused by irritation of the talc was small, a granuloma of the size of a pin's head or a pea or a flat soft disklike formation of about the size of a nail, which at an autopsy performed two or three weeks later was difficult to distinguish macroscopically from adipose tissue. Only a microscopical examination proved the tissue to be a talc tumor. We shall here present some of these cases.

*Case 1. Rat nr. 1.*

Through a 4 cm long median laparotomy incision a knife's point of talc was strewn on the small and large intestine, and most of it with the aid of tweezers introduced in between the loops of the intestine.

At autopsy performed three weeks later a tissue mass surrounding the small intestine at a length of about 15 mm and of size of about  $15 \times 11$  mm, was found at one spot of the intestine only. At this place the coils of the small intestine had become fastened to one another through adhesions which were easily resolved. The peritoneum was otherwise light and of normal appearance, neither were any changes noticed elsewhere in the abdominal viscera.

*Histological examination* of a sample from the neoplastic area showed that the layers in the intestinal wall, the serosa excepted, seemed to be normal. In the serosa and the surrounding adipose tissue granulation tissue was established, originating from loose fibrillar collagenic connective tissue. There were numerous needle-like foreign bodies (talc particles), which remained unstained with usual dyes and which, when illuminated by polarized light, scintillated. The surrounding granulation tissue contained numerous big irregular polynuclear giant cells. Many of the foreign bodies were situated within the giant cells or in the plasma syncytium composed by them. The fibroblasts in the granulation tissue were proliferating and seemed irritated. There were only comparatively few mononuclear inflammatory cells to be seen in the granulation tissue, polymorphic granulocytes were totally absent. The tissue was well vascularized with blood vessels with thin walls.

*Case 2. Rat nr. 5.*

About two knife's points antistrept powder was injected beneath the skin of the abdomen and into the muscles of the right thigh. At autopsy performed two weeks later a soft yellowish area of the size of a finger nail was established at the point of injection on the abdominal muscles, and within the muscles of the thigh a small suspicious yellowish point.

*Histological examination* of samples from both these places shows similar granulation tissue with talc particles within the muscles as in the former case. The granulation tissue is not, however, distinctly limited, but radiates with indistinct limits into the muscle bundles and fibers. In the actual granulation area there are no muscle fibers at all and in the surroundings they are fragmental and poorly stained.

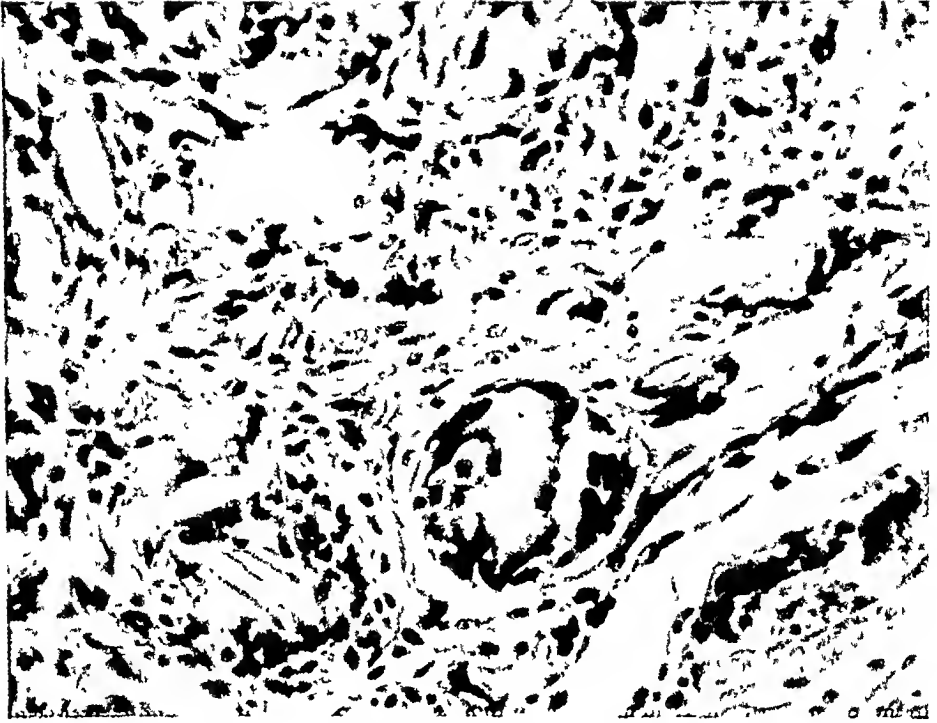


Fig. 1 The intestinal wall of a rat after a talc laparotomy. Talc crystals. Granulation tissue formed by fibrocytes, giant cells and lymphocytes. Hematoxylin-v. Gieson.  $\times 345$ .

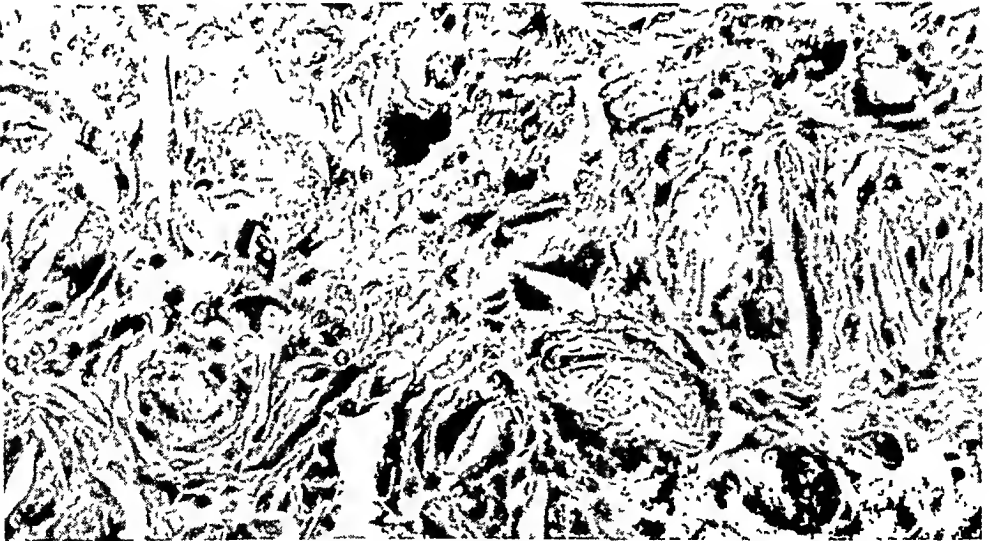
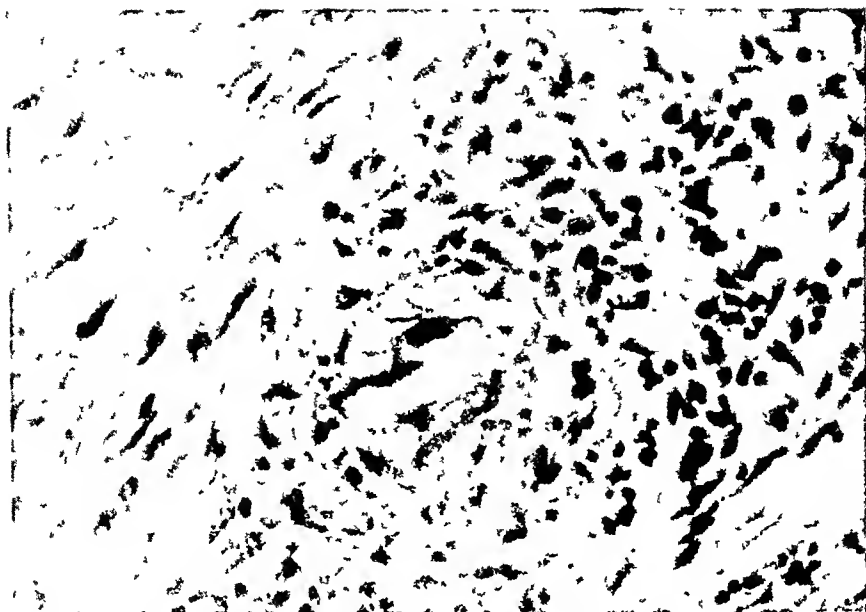


Fig. 2. The intestinal wall of a rat 8 weeks after a laparotomy with streptolysin vulnery powder. Numerous talc crystals, giant cells. Hematoxylin-v. Gieson.  $\times 345$ .



° Fig. 3. Case 1 In the centre giant cells and talc particles. In the granuloma further fibrocytic and mononuclear inflammatory cells Hematoxylin-v. Gieson.  $\times 345$

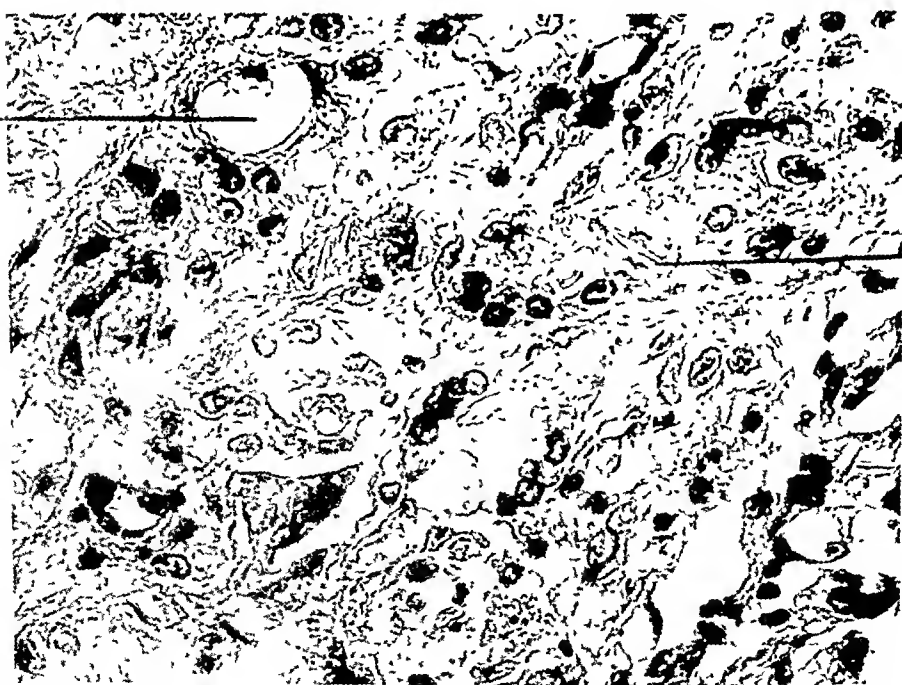


Fig 4. Case 2 Amorphous foreign body particles (a) and talc crystals (b) in the granuloma of a strumectomy scar Developing giant cells. Epithelioid and round cell infiltration. Hematoxylin-v. Gieson.  $\times 480$ .

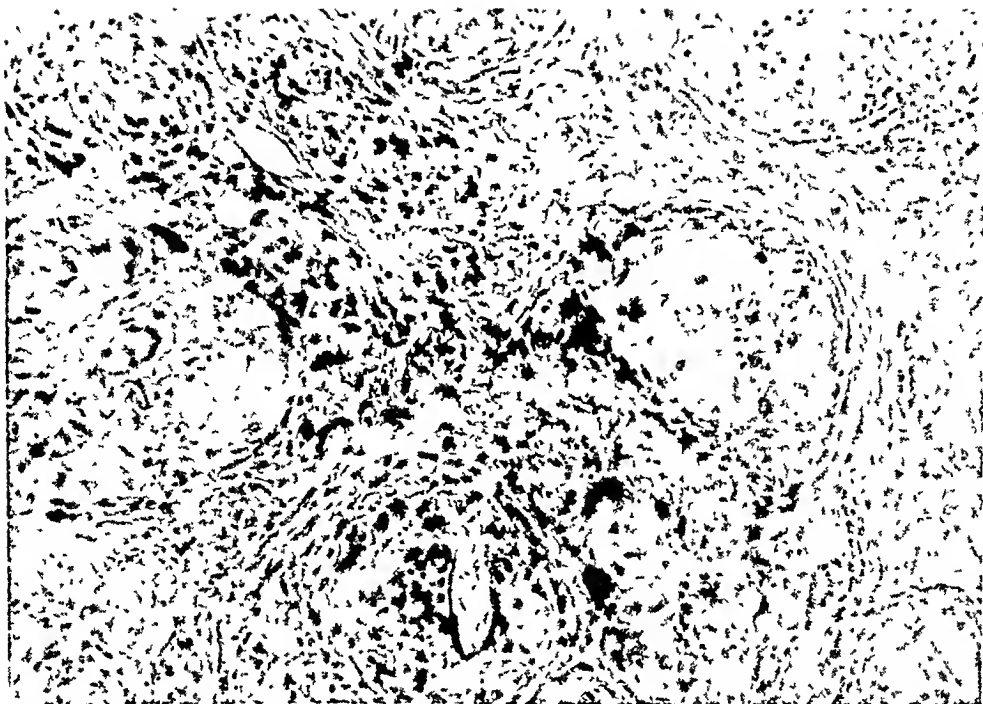


Fig. 5. Case 3. In the lower part of the picture a large talc crystal. Giant cells, fibrocytic and round cell infiltration. Hematoxylin-v. Gieson.  $\times 170$ .

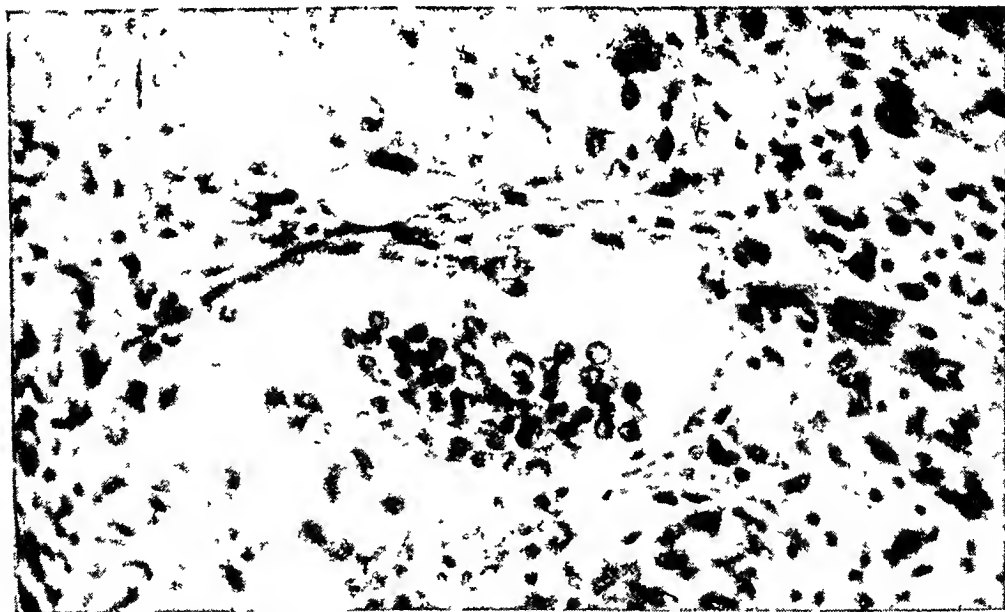


Fig. 6. Case 3. Large giant cell containing small light foreign body particles. Hematoxylin-v. Gieson.  $\times 345$ .

SAXÉN and TUOVINEN: Observations on Granulomas.



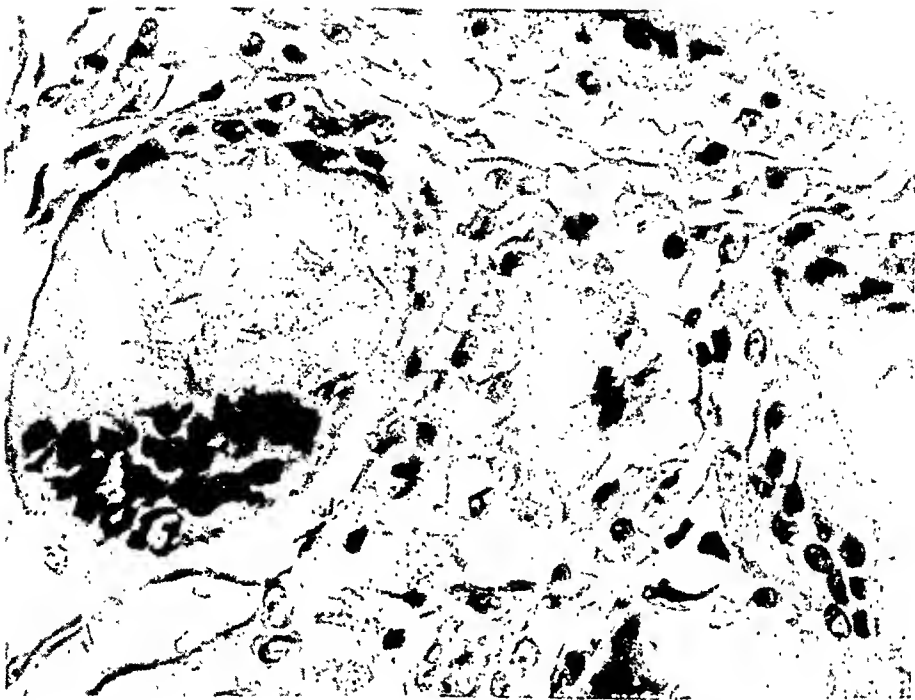


Fig. 7. Case 4. Amorphous mass and small foreign body particles in giant cells. Hematoxylin-v. Gieson.  $\times 480$ .



Fig. 8. Case 5. Considerable inflammatory cell infiltration. Long and short foreign body particles (a), giant cells and histiocytic cells. Hematoxylin-v. Gieson.  $\times 170$ .

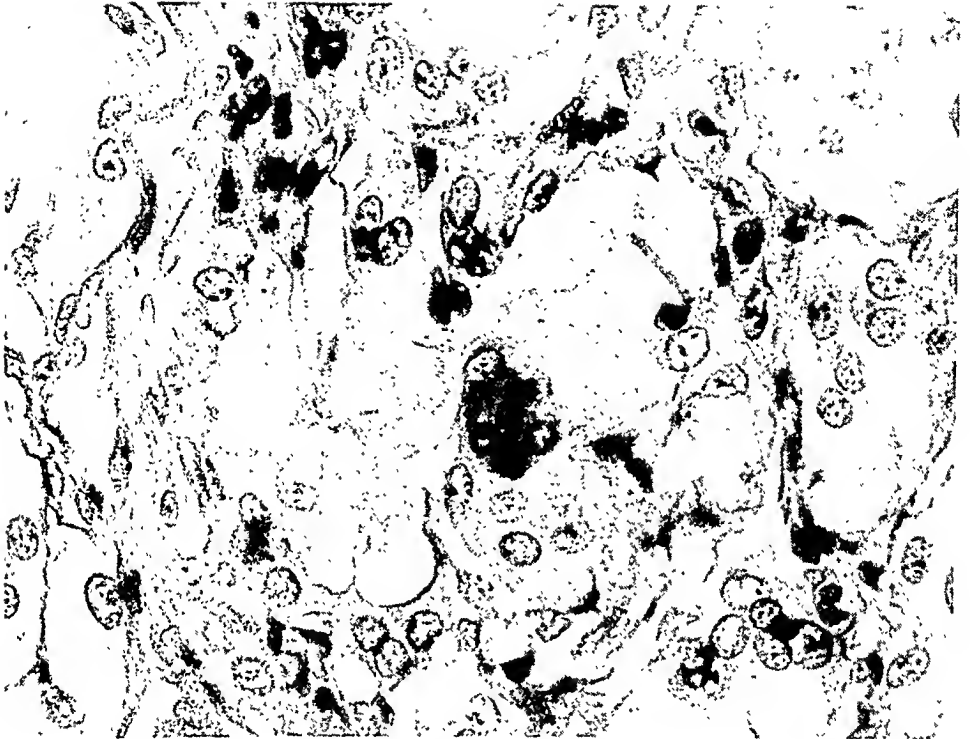


Fig. 9. Case 6. Irregular weblike foreign body mass, giant cells, lymphocytes and fibrocytic cell. Hematoxylin v. Gieson.  $\times 480$ .



Characteristic of this case as compared with the former is that, apart from lymphocytic cells, there are also a few polymorphonuclear neutrophil granulocytes.

It must therefore be said that in both cases described above in which talc was either injected into the tissue, or strewed into the abdominal cavity without any greater violation of the tissue, the changes were trifling in spite of the comparatively great quantity of talc.

On the other hand it can be established that, if talc powder is strewed into the tissue as in the cases described above, a considerable foreign body reaction may occur, should a larger quantity of powder be applied. In the following a case will be reported in which three knife's points of talc was strewed into the abdominal cavity.

### *Case 3. Rat nr. 14.*

Laparotomy incision. A generous three knife's points of talc powder was strewed principally between the coils of the large intestine. At autopsy one week later it was established that the whole talced area had changed into a firm bundle in which the separate coils of intestine were difficult to distinguish.

*Histological examination* of a sample from the central portion of the intestinal bundle shows that the mucosa of the intestine looks normal. Outside the muscularis mucosae there is much granulation tissue comprising all outer layers of the intestinal wall, and fixing the adjacent coils of intestine to one another. In the granulation tissue there is much talc particles surrounded by inflammatory cell infiltration and a loose mesenchymal tissue in which already precollagenic fibers, lightly stained red with v. Gieson, are found. The fibrocytes are distinctly proliferative, and in places there are also syncytial plasma accumulations in which the limits of isolated fibroblasts may still be indistinctly distinguished. Such 'completed' giant cells which are numerous in older cases, occur, however, very sparsely here. Among the blood corpuscles in the inflammatory cell infiltration leukocytes dominate, in places forming small abscesses. There is further a considerable hyperemia and edema of the tissue.

The animal experiments now reported show, and the one hand, that talc powder which has gained entrance into formerly not injured tissue may cause a considerable foreign body reaction with ensuing granulomas. On the other hand the experiments proved that a smaller quantity of talc strewed into the tissue under similar circumstances may become resorbed in a short time, leaving either no permanent traces or only trifling granulomas.

These observations seem to be in some respects contrary to those of SEELIG, VERDA and KIDD, according to whom even a very small quantity of talc, for instance, that which finds its way into the operative field from a perforated glove, may be sufficient to cause considerable and fatal tissue changes. It may thus be assumed that, in addition to talc, other factors occur through which real large talc tumors would develop, important changes of the kind reported especially in American literature.

It was evident in our animal experiments that one such factor, probably the most important, was *injury of the tissue* and the rubbing of talc or powder containing talc into the injured tissue. Not until the tissue has been violently bruised mechanically, for instance with tweezers or Péan's forceps, and the injured tissue impregnated with the powder, large granulomas injurious to the function of the organism develop in the experiment animals. In the following some examples of such cases will be given, the cases being presented chronologically from earlier changes to older ones.

*Case 4. Rat nr. 7.*

2 cm right of the median line 2 cm long incision into the skin of the abdomen. Also an incision into the medial side of the left thigh. The muscles having been bruised with tweezers, two knife's points of antistrept wound powder is rubbed into the tissue. The rat died three days later. At autopsy the cause of death was established to have been pneumonia.

*Histological examination* of the areas treated with the powder shows a considerable purulent necrotic inflammation in the subcutaneous tissue. In the center of the necrotic areas there are at many places talc particles. Foreign body giant cells are also found, but they are considerably fewer and smaller than in cases in which autopsy was performed at a later stage. They appear like a conglomerate of fibrocytes. The fact is that there are in many places fusiform/progressively changing fibrocytes with irregular plasma offshoots; these fibrocytes seem to be just on the point of fusing, their limits can still be distinguished although often with difficulty.

*Case 5. Rat nr. 15.*

Laparotomy incision. Among the coils of the large and small intestine 3 knife's points of talc is strewn, the talc being rubbed into the serosa by pinching the serosa with a needle holder.

At autopsy two weeks later it is found that in the area, into which talc was introduced, is a bundle of intestine in which the coils are fixed one to the other with firm adhesions.

*Histological examination* shows also in this case a normal intestinal mucosa, and the muscularis mucosae is everywhere distinct. Outside the latter a granulation tissue is seen comprising all outer intestinal wall layers, and fixing the coils of intestine one to the other in a bundle. The granulation tissue is rather firm and its collagenic fibers stain red with v. Gieson. There is an abundance of talc crystals in accumulations surrounded by giant cells. The inflammatory cell infiltration is principally lymphocytic, but within the granulation tissue necrotic areas are seen here and there; there are comparatively many leukocytes in these areas and around them.

*Case 6. Rat nr. 19.*

Laparotomy incision. The intestines are pinched with tweezers and a needle holder. Two knife's points of talc are rubbed in among

the coils of the large and the small intestine. Through a cut on the inner side of the right thigh and in the muscles of the abdominal wall, the muscles are pinched as in the previous cases. Into both wounds two knife's points of talc is rubbed.

At autopsy eight weeks later it is stated that the peritoneum of the anterior wall is coarse, uneven and adhered to the liver, omentum and, in places, to the small intestine. On the surface of all these viscera talc is seen as a white concretion, totally about one knife's point. The powdery concretion continues between the coils of intestine to the mesentery. A sample is taken from the omentum and the small intestine. On the inner side of the thigh there is on an area of the size of a finger-tip a pale tissue attached to the muscle. In the abdominal wall there is a similar tissue indistinctly limited towards its surrounding.

*Histological examination* shows, in the intestinal wall just outside muscularis propria and in the serosa, granulation tissue containing numerous talc crystals. These are situated in a firm collagenic fibrillar tissue immediately surrounded by a cell layer composed of histiocytes resembling epithelioid cells, and of cell syncytium (of giant cells). The infiltration of round cells is comparatively small, and formed only of lymphocytes. There are few blood vessels in the granulation area. In a muscle of the thigh a granuloma is found, the structure of which is quite similar to the granulation tissue found in the abdominal cavity and described above. In the border areas of the granulation tissue numerous necrotic muscle fibers are seen.

In the muscles of the abdominal wall there are also isolated isles of similar newformed tissue.

Common to these cases (4.—6) is that necrosis was caused through the crushing of the tissue, and that the talc introduced into the tissue thus injured, caused a strong foreign body reaction with considerable granulation formation. Evidently the mechanical trauma made the absorption of the talc impossible or at least highly difficult, as the injured vessels make resorption impossible.

This is thus the reaction regularly brought on by talc in cases in which the tissue is injured so as to cause total necrosis, and in which talc or a powder containing talc is richly introduced. It should be mentioned that in tissue similarly injured the experiment animals develop small foreign body granulomas even when the quantity of talc is quite small. This refers, however, to a few cases only. In the rest there are no granulomas, and at autopsy performed two weeks later no trace of a reaction is found. In these cases the talc has been resorbed by the tissue. We have not been able to establish on what factor this irregular occurrence of granulomas in the above cases depends. The inconstancy of the results may be due to such small technical

differences in performing the tests which cannot be controlled. Individual disposition is hardly of any greater importance even if this is the fact, for instance, in human silicosis. It is well-known that of persons exposed to stone dust in a similar way a part is affected by silicosis while others remain sound.

As a result of our experimental investigations on the pathological changes caused by talc and wound powders containing talc, we have established that

1. a small quantity of talc introduced into uninjured tissue is generally resorbed in a short time without leaving any traces,

2. a large quantity of talc powder introduced into uninjured tissue may often cause considerable foreign body granulomas,

3. similar granulomas occur regularly in tissue mechanically injured so as to cause serious lesions into which talc is rubbed. In this case comparatively small quantities of talc cause granulomas which are preceded by purulent inflammations in the necrotic area.

4. a chemically clean sulfonamide powder disappears from the animal tissue causing no histological changes.

### Clinical Cases.

For the clinical investigation of foreign body granulomas we have collected cases from the Pathological-anatomical Institute of the University of Helsinki. There were 6 cases during the period 1. 10. 45—31. 12. 46. During this period 5,241 samples were examined in the institute.

As already established in our animal experiments, giant cells develop easily through a reactive process already some days after the introduction of talc in the tissue. Through the growth of cell syncytia, carefully observed in our animal experiments, they lead to the development of granulomas. It will appear from the following to what extent the development of granulomas in the human body resembles that in animal organism. The clinical cases described below will simultaneously picture the importance of these granulomas for the human organism both clinically and pathologically-anatomically.

#### *Case 1. Disabled soldier, aged 35.*

The patient was wounded on July 14th 1941 by a shellsplinter in the back, vulnus bomb. penetrans thoracis l. sin. The injury was

followed by a chronic empyema of the left pleura and an intrathoracic foreign body was found on the left side. After thoracostomy in 1943 the cavity was rinsed with solutions of cibazol, pneumazol, and other substances, the character of which does not appear from the record. In May the same year thoracoplasty was performed and rinsing with cibazol was repeated. In the latter half of the same year thoracoplasty was twice repeated. Sulfathiazole tablets were introduced into the wound which was plugged with tampons. In 1945 there still remained thoracic fistulas, and in the beginning of that year two thoracoplasties were again performed. On April 25th 1946 a plastic operation was once made and the thick wall of the pleural residual cavity was removed. A histological sample was taken of this wall exhibiting the following changes:

*Histological examination (1401/46):* Firm cicatricial tissue in which is seen a usually focal, often perivascular lymphocytic infiltration. In some lymphocytic foci distended fibrocytic cells and some polynuclear giant cells are observed. There is no foreign substance in the area of the pure lymphocytic infiltration. There are also a few infiltrations in which the giant cells are completely free from corpuscular foreign bodies. In others there is, in the giant cells, an almost amorphous mass, in which, however, an unclear threadlike structure sometimes occurs. This scintillates highly in polarized light, whereas the infiltrations here described are otherwise completely free from refracting substances. In the tissue are further found loose focal irregular infiltrates, in which numerous foreign body giant cells occur, and in which, besides the mononuclear inflammatory infiltrate, numerous leukocytes appear. The giant cells contain unstained needle-like foreign bodies in great numbers with strong light-fractioning capacity. Such foreign body granulomas occur only in some areas in the centre of the fibrotic tissue.

#### *Case 2. Woman, aged 39.*

On the 1st Febr. 1946 an excision of an abscess in the gluteal region was performed. Streptolysin powder was richly introduced into the wound. The patient was treated for goiter by the same physician in April the same year. On the 5th April *resectio strumae subtotalis bilateralis* was performed in novocain anesthesia. Some large nodes and several small cysts were established. A thin continuous catgut suture in the subcutaneous layers. Into the centre of the wound a drain was placed, which was removed the following day. When the drain was removed, streptolysin wound powder was introduced. The patient discharged as convalescent, and was granted three weeks leave. During these weeks a very tender protrudent cicatrix developed in the place of the drain. On the 3rd May the patient arrived again for treatment as both the gluteal and the goiter scars were very ugly. The latter was situated in the middle line in the place of the drain. On the 19th August the cicatrices, and on the 23rd August their thin intracutaneous suture were removed. Samples of the scars were taken for histological examination.



*Histological examination (2827/46).* In the scar in the gluteal area the tissue under the somewhat horny epidermis is a comparatively firm fibrillar connective or cicatricial tissue, in which sparse inflammatory round cell infiltration, principally constituted by lymphocytes, is seen, particularly around the hair follicles and sebaceous glands. No giant cells or any foreign bodies can be found here, and these areas are polariscopically completely inactive. There are, however, deeper in the subcutaneous connective and adipose tissue some granulomas, in which besides lymphocytes and fibrocytes also some typical foreign body giant cells occur. These contain either a spumous light unstaining substance inactive in polarized light, or short needles which scintillate highly, and which are divided into short thin fibres. The granulomas are surrounded by rather firm connective tissue.

In the sample of the strumectomy scar there is also under the horny skin of varying thickness cicatricial tissue in which sparse lymphocytic round cell infiltration may be observed, particularly around the thin-walled blood vessels. Even here granulomas are found but deeper in the subcutaneous connective and adipose tissue. They are here much more numerous than in the sample of the gluteal scar. Their structure is looser. The surrounding connective tissue is not so firm, and there are many more foreign body giant cells. These are as rich in similar scintillating needles as the sample described above (case 1). Further homogeneous large round formations almost unstaining or grayish in v. Gieson preparation are observed partly within giant cells, partly in free connective tissue. They are surrounded by solitary cells resembling epitheloid cells. In polarized light these formations do not themselves refract, but they generally contain some needle- or crystal-like highly refracting matter. There is an abundance of lymphocytic round cell infiltration and also some polymorphonuclear granulocytes in the area of the granulomas.

*Case 3. Engine driver's wife, aged 47.*

The patient arrived in the hospital in December 1945 because of a nodule in a laparotomy scar. 11 years ago laparotomia, enucleatio myomatis uteri et antesuspensio uteri et appendiceetomia had been performed. There was nothing worthy of note in the operation report. Histological examination proved the tumor to be a common fibromyoma. Healing by first intention. In an operation performed in 1945 a node, of the size of a finger-tip, was removed from the lower end of the laparotomy scar. A sample was taken for histological examination.

*Histological examination (3790/45).* The tissue consists of roundish granulomas of various sizes, separated from each other by streaks of firm fibrillar tissue. The granulomas are constituted of collagenic connective tissue. In this reticular connective tissue a sparse lymphocytic round cell infiltration and irritated fibrocytes are seen. The most striking cell formations are numerous polynuclear giant cells. In these, a light, spumous, often almost amorphous matter is found, which polariscopically is completely inactive. Only in a few cells needle-like foreign bodies are observed, which have often dissolved into

isolated twisting and indistinctly limited fibres. Foreign bodies seintillate clearly in polarized light. The foreign body within the giant cells remains unstained in dyes used by us.

*Case 4. Farmer's daughter, aged 21.*

The patient was admitted in the hospital on Dec. 29th 1945, the diagnosis being phlegmone reg. glutealis sin. On incision a large quantity of staphylococci pus was found. When the patient was discharged on Jan. 7th 1946 there was still some pus in the wound. In April the patient returned because the incision wound was still open, and pus was still present. The secretion was rich in yellowish granules, and actinomyces was suspected. It appeared, at the same time, that the patient had received three series of Bi injections as treatment for lues, latest November 1945. On May 7th excision of the wound cavity was performed, and a sample of its wall was sent for histological examination.

*Histological examination (1577/45).* The sample exhibits irregular, generally round or oval necrotic tissue areas limited by giant cells. These form large continuous plasma syncytia. Towards the periphery of the granulomas there is a capsular layer of connective tissue consisting of collagenic fibres. In this layer numerous lymphocytes and plasma cells can be seen. There are, however, only a few leukocytes. The necrotic centre of the granulomas contains an abundance of needle-like foreign bodies, which remain unstained in the samples, and refract highly in polarized light. Similar needles, although fewer, are found within the giant cells.

*Case 5. Farmer's wife, aged 40.*

The patient was operated on, through the vagina, in 1945, for prolapse of the uterus. In April the same year, after a recurrence, ventrosuspensio uteri a. m. Gilliam was performed. The fascia was found to be frail and tore easily. There was much adipose tissue. During the operation the glove was torn and, fearing infection, the operator introduced about a tablespoonful of sulfa-powder (marfanil-prontalbin Bayer) into the abdominal cavity and the subcutaneous tissue. Healing by first intention. After half a year the patient was again admitted into the hospital. Since the operation the patient had not felt quite well. Some two months after the last operation she had felt pain in the abdomen, which was tender on the lower right side, where an induration, about the size of a clenched fist, was found, and believed to be a periappendicular abscess. The S. R. remained increased (40/50 mm 1 hr). On admission in October 1945 the patient was pale and looked tired. To the right in the abdomen somewhat below the umbilicus a tender and partly mobile soft induration, of the size of a woman's fist, could be felt. On Oct. 5th laparotomia, resectio ilii et appendicectomia were performed. The induration appeared to be a bundle of intestines fixed to the abdominal layers. The intestines were firmly attached to each other for a distance of half a meter of the ilium orally about 1 m from Bauhini's valve. The mesentery was greatly distended.

The bundle was suspected to contain an abscess, and it was resected totally. The abdominal cavity was rinsed with salt solution and sulfathiazole powder was introduced. Powder was also applied to the abdominal walls. From the thickened wall of the resected small intestine a sample was taken for histological examination. The wound healed by first intention, and the patient was discharged as convalescent on Oct. 27th, 1945.

*Histological examination (2902/45).* In the mucosa of the intestine some superficial erosions are found. In all parts of the intestinal wall, particularly in the serosa, there are marked inflammatory changes. Numerous leukocytes are found among the inflammatory cells. In the intestinal wall near the serosa old foreign bodies can be seen. These are homogeneous, in v. Gieson unstaining or slightly grayish thick sausage-formed or ball-like pieces surrounded by foreign body giant cells or by histiocytic cells resembling epithelioid cells. In polarized light they are inactive: the contours of the larger peg-like bodies only appear vaguely and diffusely illuminated.

*Case 6. Banker, aged 71.*

The patient had undergone hemorrhoidectomy in 1914. The hemorrhoids recurred, were burned and treated with injections. Some ten years he suffered from internal hemorrhoids which bled occasionally. Because of the hemorrhoids and an unbearable anal irritation the patient received in March small quinine-urethan (5 %) injections into the anal skin and at the limit of the mucous membrane. When blood appeared again in the feces the patient was admitted into hospital for closer examination.

The general condition was satisfactory. Per rectum the mucous membrane was found to be normal. To the right, just by the lower edge of the prostata in the anterior wall a pit, of the size of a finger-tip, was palpated, the lateral walls of which were rather firm, smooth and untender. At the right edge of the wall there was a nodular firm ridge about the size of a finger-tip and narrowing downwards and forwards. The nodule was mobile with the mucous membrane of the rectum and distinctly limited. In rectoscopy the mentioned ulcerous pit was bloodshot, and the bottom was necrotic.

As these observations pointed to a fairly probable malignant tumor, extirpation of the rectum and sigmoidostomy were performed on July 8th 1946. A sigmoid coil of about half a meter was released, resected and invaginatedly fixed pending sigmoidostomy. The floor of the pelvis was peritonized and after closing of the laparotomy wound the rectum was removed by way of the sacrum. Sulfa-powder was richly introduced into the wound, and a tampon was applied. The patient recovered satisfactorily. In the beginning of October there was not even secretion from the old anus and the preternatural anus functioned well. A sample was taken of the removed rectal tumor.

*Histological examination (2351/46).* Rather deep in the tissue, chiefly within the muscular layer, large irregular granulomas are seen. In places small necroses are found in the tissue. The granulomas are

indistinctly limited, and separated from each other by muscle fibres or by a comparatively compact collagenous connective tissue. The granulomas consist of thin praecollagenous fibres, some lymphocytes, fibrotic cells and principally of giant cells of foreign body type and varying size and shape. In the region of the granulomas there is an abundance of fibrous matter, staining yellow in v. Gieson preparations. In this mass thin threads form an irregular network. Similar matter is also found in the giant cells. No needles or crystals can be seen and the granuloma areas are polariscopically completely inactive.

### Observations Based on the Clinical Cases.

Before dealing with observations based on clinical cases, some circumstances in connection with the production of tablets must be stressed. Apart from the active drug, in our cases the sulfa-preparation, tablets consist of substances added during preparation. These are divided into four groups. 1. Complementary material is used when the quantity of the drug is too small to obtain a tablet of suitable size. Such substance is, for instance, sugar, lactose or chalk. 2. As solving agent starch is used. 3. As excipient glue, mostly gum arabicum is used. 4. As an emollient, which prevents the tablets from adhering to the machine or to each other, talc is used, the fatty consistency of which well suits this purpose. The substances of the first three groups are thus organic, chalk excepted, but the principal substance in the fourth group is talc.

When judging the particular importance of *talc*, magnesium silicate, for the development of granulomas, we have found, based on our cases, that in cases 1 and 2 both the past history and the clinical picture of the disease together with the histological picture indicated, as plainly as can be desired, that the irritation caused by the talc played a rôle on the development of the symptoms.

Based on cases 1 and 2 we have considered it obvious that the talc contained in the vulnerary powder was the reason of certain tissue changes. It may be questioned, however, whether other substances contained in sulfa-wound powder, such as, for instance, p-aminosulfonamide, urea and amyllum may not take an active part in the development of the change. Animal experiments show that sulfonamide is soon resorbed in the tissue causing no permanent changes. From a histological examination appears, on the other hand, that numerous refracting needles were found,

in the area of the granulomas, particularly in giant cells, and that these changes were quite similar to those established in animal experiments. Urea and amylum, which are probably easily resorbed, do not polarize light. As will be related later cases 5 and 6 show, however, that also such substances which are generally quickly resorbed in the tissue, and which soon disappear may, under certain circumstances, remain for a long time in the tissue causing similar granulomas with foreign body giant cells as does talc. These granulomas can, however, easily be distinguished from talc granulomas in a histological examination. The foreign body remaining in the tissue looks different, and there are, above all, no refracting needles, which characterize the talc powder. As already mentioned it is evident that, in these two cases, the talc contained in the powder or tablet was the cause of the development of the granulomas. It should be stressed, however, that great care should be taken in judging a case, and that polarized light should always be used in histological examination before foreign body reactions are ascribed to talc.

When comparing the development of the pathological process in the above two cases with experiences of our animal experiments, it should first be established that the granulomas have developed under similar circumstances. Both in the animal experiments and in the clinical cases the quantity of talc introduced into the tissue was considerable. There were also obvious tissue lesions. In the operations the tissue had to be mechanically injured. In our cases — the struma case excepted — attention should further be paid to the infection which also caused tissue necroses.

It is particularly interesting to follow the changes and variations which the *giant cells* undergo in granulomas of different ages. In the beginning (the strumectomy, case 2) they are larger, contain more plasma, are more succulent, and numerous talc needles can be observed in them. In older cases the giant cells seem to become smaller at the same time probably decreasing in number. One also gains the impression that they do not longer contain so many talc needles. When examining granulomas of different ages the impression is that the structure of the foreign body and, at the same time, the contents of the giant cell change character. The needles are at first sharp with distinct limits. Gradually the contours become more indistinct while at the same time the needles dissolve into numerous thin and short but twisted threads. In this stage the foreign substance still highly

refracts light. In still older granulomas numerous giant cells with no corpuscular contents are found. Finally, in case 1, small granulomas are established in firm fibrous connective tissue in an area where the process may be considered oldest. In these granulomas there are only a few small dwarfed polynuclear giant cells, the plasma of which has no contents.

There may naturally be different opinions as to whether and how far definite conclusions on the stages and the dissolution of talc in the tissue may be drawn, based only on histological examination. It must be admitted, however, that such transitional pictures turn the thoughts in a certain direction. We know from earlier experimental investigations that quartz, a close chemical relation of talc, is partly dissoluble in tissue fluids, and that released silicid acid is considered the active agent causing changes in the lung in silicosis (KING, MC GEORGE, WHITEHOUSE). We may assume that the changes in giant cells and talc needles which could be established in the granulomas of various age in our cases, might be explained thus: the talc is gradually decomposed, and may finally dissolve and even be resorbed into the tissue while the foreign body giant cells also disappear, leaving only a fibrous firm cicatricial tissue. Our animal experiments cannot elucidate this problem as our cases are too young — 8 weeks at the most — to allow a microscopically distinguishable dissolution of the talc powder.

Similar microscopical pictures which we have above assumed in cases 1 and 2 to occur through the dissolution of talc, are found in case 3. Here a granuloma, of the size of a finger-tip, had developed in a laparotomy scar, and was excised 11 years after the laparotomy. It does not appear from the journal whether the operative field had been contaminated with talc in connection with the laparotomy. The histological examination, however, speaks strongly in favour of this possibility.

The material also comprised a fourth case (4) in which the granulomas have probably been caused by talc. In this case there is no information, however, as to talc having possibly been introduced into the tissue. In connection with bismuth injections an inflammation and an abscess a purulent inflammation had developed. It may, of course, have been a question of foreign body changes caused by the bismuth salt — the basic bismuth salicylate — but the similarity of the case with the talc cases speaks in favour of a talc granuloma. It is quite probable

that a powder containing talc was used in connection with the first incision, and that this powder then remained in the necrotic tissue from where it found its way through phagocytosis into the giant cells. Owing to the reaction being of comparatively short duration, 4 months only, no dissolution could be microscopically established in the needles.

In cases 5 and 6 of our materials, talc as the cause of tissue changes, may be eliminated. Both cases prove that also such substances which are generally considered as easily soluble in the tissue fluids, or comparatively readily absorbed, may sometimes cause considerable foreign body reaction.

An interesting feature in case 5 is that even after the histological examination it was believed to be a question of a talc tumor. Marfanil-prontalbin contains, according to the table, pure sulfa-powder: 1 part marfanil (p-aminomethyl-benzol-sulfonamide hydrochloride) and 9 parts prontalbin (p-aminophenyl-sulfonamide). Because of postoperative abdominal pain a second laparotomy was performed about five months after the first one. An intestinal bundle was found which was fixed to the abdominal layers, the coils of which were highly adherent to each other at a length of about  $\frac{1}{2}$  meter. The bundle was suspected to contain an abscess, and it was totally resected. As an abundance of granulation tissue with giant cells containing foreign bodies was established in the histological examination, it was assumed that it was a case of talc tumor. A later histological examination, however, proved this assumption to be wrong.

In trying to elucidate the genesis of the granulation tissue in case 5 attention should be paid to the fact that considerable tissue lesions and necroses occurred in the first laparotomy. Into the injured tissue marfanil-prontalbin powder was richly introduced. It is quite probable that in these circumstances the powder was not resorbed, but clogged remaining unresorbed in the necrotic tissue. It caused a reactive purulent inflammation which was still easy to establish five months after the operation.

It is interesting to note that in the second evident talc tumor case, in the strumectomy scar granuloma (case 2), similar ball-shaped homogeneous foreign bodies were found as in the case described above. Our opinion is that, in this case, the streptolysin wound powder with all its chemical substances had partly not resolved, possibly just in the necrotic areas as in the former case.

The talc contained in the ball-shaped bodies was here also to be seen only by the aid of a micropolariscope.

In case 6 quinine-urethan injections had been used for treatment of hemorrhoids. It is probable that the injections have caused tissue necroses and possibly also an infection, and that the injected substance remained in the necrotic tissue without being resorbed, by irritation causing a foreign body tumor.

As already mentioned, cases 2, 5 and 6 show how foreign bodies — here a streptolysin vulnerary powder, marfanil-prontalbin powder and quinine-urethan solution — introduced into injured or necrotic tissue, may remain there for a long time causing granulomas typical of foreign bodies, notwithstanding the fact that these substances are generally dissolved in the tissue fluids and resorbed.

Further these cases prove that great care should be taken when judging the etiologic rôle played by talc especially in the genesis of postoperative foreign body granulomas. Talc particles are, however, generally easy to distinguish from other foreign bodies considering the structure of the crystals and their reaction in polarized light.

### Practical Conclusions.

Considering the results of our animal experiments as well as the experiences furnished by the clinical material the following practical conclusions may be drawn:

*Talc powder* remains in the tissue for a long time causing granulomas with a character typical of foreign body tumors. After some years, however, a decrease in the quantity and size of the talc crystals can be noticed, and one may be entitled to believe that the talc is resorbed in the tissue at least to a certain extent. The occurrence of talc in the tissue has injurious consequences, which vary according to into what tissue talc has been introduced.

Talc is introduced into the tissue principally in one of the following ways:

When the glove of the operator tears the operative field is contaminated with talc. The seriousness of this fact is stressed by the above mentioned American authors. In only one of our clinical cases (case 3), and even here with some doubt, talc was introduced into the tissue by means of a glove.



So-called *wound powders* consisting of sulfa-preparations — in our country the antistrept and streptolysin wound powders containing 33—35 per cent talc — contain such a large quantity of talc that the introduction of such powders into the tissue through an operated wound gives rise to granulomas. Particularly when the tissues are in some way or other injured, as is frequently the case in operations, the chances of development of granulomas are considerable, and the postoperative complications accordingly serious.

Sulfa-tablets regularly contain, as do generally also other tablets, talc and they are not meant to be introduced into the tissue through operation wounds. Through the use of such tablets granulomas may arise.

Under certain circumstances as, for instance, in connection with tissue lesions occurring during an operation, *pure sulfa-powder* may also cause a granuloma. Here the chemical substance, generally resorbed in the tissue, may, though seldom, cause a foreign body granuloma which may be found quite a long time after the operation.

Other substances, which normally dissolve in the tissue, and which are intended to cause an aseptic necrosis, may, under certain circumstances and in suitable tissue, cause tumors of foreign body type. *Quinine-urethan* is such a substance. Basing our opinion on these conclusions we consider that there is no reason to change talc which is of great importance in practical surgery for other substances which dissolve in water and in tissue fluids. Nevertheless care should be taken in connection with introduction of talc into the tissue.

### Summary.

On the basis of animal experiments and clinical cases the authors have investigated talc tumors and some other granulomas. In the animal experiments, for which full-grown rats were used, talc was introduced either into the peritoneal cavity or into the muscles. In the experiments sulfonamide powder was also used, either chemically pure powder (streptolysin, Orion) or sulfonamide wound powder which contains either 33 per cent (antistrept wound powder, Medica) or 35 per cent (streptolysin wound powder, Orion) talc. For the examination of the foreign body granulomas polarized light was used, in which talc crystals

appeared distinctly either in necrotic tissue or in cell syncytia; also in other foreign body particles such as, for instance, sulfonamide talc crystals were often found.

Based on the animal experiments it was established that:

1) a small talc quantity introduced into uninjured tissue is generally resorbed in the tissue in a short time causing no changes,

2) if a large quantity of talc is introduced into a formerly non-injured tissue considerable body granulomas frequently occur,

3) similar granulomas arise regularly when severe tissue lesions with ensuing necrosis are caused. Here granulomas are caused also by comparatively small quantities of talc and they are preceded by a purulent inflammation,

4) a chemically pure sulfonamide powder disappears from the animal tissue leaving no traces.

The clinical cases are 6 foreign body granulomas. Even if the talc remains in the tissue for a long time here is reason to assume that it is to a certain extent resorbed. The authors consider the contamination of the tissue with talc through torn gloves to be a rare occurrence. On the other hand talcous sulfa wound powders introduced into the operative field may easily cause granulomas and consequently postoperative complications. Under certain rare circumstances such as tissue lesions caused in an operation, pure sulfa-powder may also give rise to granulomas.

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From Karlskoga County-Hospital.  
(Chief: Dr STIG LINDGREN, M. D.)

# **On Injuries of Bone and Bone-Marrow after Intraosseous Injections.**

**An Experimental Investigation.**

By

LENNART WALLDÉN.

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For therapeutic purposes intra-ossseous injections were in all probability first utilized by A. JOSEFSON, who in 1934 published a work on intrasternal administrations of campolon in cases of pernicious anemia. But not until after 1940 have punctures of the bone-marrow become more prevalent as a therapeutic method through investigations made by HENNINGS (1940), and TOCANTINS as well as O'NEILL (1941), who proved that an injection into red bone-marrow is to its effect analogous with an intravenous administration. This technique has subsequently come into more use in such situations as when an intravenous injection is desired, but where a venal puncture cannot, for some reason or other, be carried out. Especially shock-cases with injuries which make intravenous transfusions more or less impossible and which have accumulated considerably during the war, seem to have been a rich material for the employment of intra-osseous procedures. By this method it has been possible to administer blood, solutions of salt, and stimulants of various kinds to the injured in a technically simple and efficacious way. The method has been tested out and recommended for heparin treatments in cases of thrombosis (LINDGREN and WALLDÉN) and for intrasternal narcosis with narcotal and evipan (DALGAARD).

Under these conditions it was reasonable to use the intraosseous technique when infusing X-ray contrast-mediums for urographing cases where venal puncture was difficult or impos-

sible to carry out. The method could be particularly valuable when urographing cases where venal puncture was difficult or impossible to carry out. The method could be particularly valuable when urographing children. But it was of course imperative that the injection should not cause injuries that might result in more or less permanent functional disorders of the bone-marrow or the bone. From a theoretical point of view it might be expected that the common contrast mediums soluble in water which are employed in intravenous injections could on account of their high concentration, which makes them considerably hypertonic, cause injuries of the bone-marrow. In earlier investigations the present writer found that a careful injection of undiluted uroselectan B into the sternum of an adult brought about a sharp reaction of pain. But after diluting the contrast medium into an isotonic solution this technique is practically available. This method has been described in greater detail in *Acta Radiologica*, 1944. There, special stress is laid on the importance of diluting the contrast medium into an almost entirely blood-isotonic concentration. With reference to DALGAARD's publication concerning intrasternal infusions of narcotal, the present writer (1946) has even for this purpose proposed a dilution of the considerably hypertonic narcotal, employed intravenously, into an isotonic solution.

In literature on intra-osseous injections which is at present quite extensive, data concerning complications and injuries are scanty. However, this fact may no doubt be considered favourable only by appearance. Unfortunately, information as to less successful experimental results of a new method is often slow in coming to our knowledge. Even in their first work on this question, TOCANTINS and O'NEILL warn against an injection into the bone-marrow under septic conditions, owing to the risk of osteomyelitis possibly prevalent there. They also emphasize the possibility of injuries from an injection of hypertonic or other irritative solutions. The importance of these reservations is elucidated by a few works from Scandinavian countries. Thus CHRISTIANSEN (1945) informs us that in a few cases, after an intraosseous injection of X-ray contrast-mediums for the purpose of urography (a 70 % uroselectan B), he observed *periosteal reaction along the bone into which the solution of contrast was injected*; and SØNDERGAARD (1946) publishes five cases of *osteomyelitis after intra-osseous infusions*. These five cases are included in a material

of 750 intra-osseous infusions, which result in an osteomyelitic frequency of approx. 0.67 %. According to specifications given, the origin of these injuries may be explained either as due to an unreliable asepticism, a hypertonic solution, or a septic condition of the patient. HEINILD, SONDERGAARD and TUVAD (1947) have compiled a material of 1,000 intra-osseous infusions. In 23 patients, an injection of a 50 % glucose was made 32 times. Three of these patients contracted osteomyelitis after the injections, which implies a high frequency for this group since the whole material comprises only five cases of osteomyelitis after intraosseous injections.

As an illustration of the injuries that may arise after inappropriate intra-osseous injections, the present writer can adduce one case. It concerns an one-year-old boy affected with purulent meningitis to whom sulfathiazole was administered every fourth hour for five days into a bone-marrow-needle remaining in the tibia. The meningitis was healed. The patient appeared healthy. When he was about to be discharged from the hospital, however, a swelling of the lower leg was observed where the injections had been made. In the X-ray (Fig. 1) *thick periosteal deposits were to be seen along the surface of the entire bone*, which furthermore revealed, *alternating attenuations and concretions*. The roentgenography reminded us in a high degree of that of osteomyelitis. But the patient was without a fever, had a normal sedimentation-reaction, and normal blood corpuscles. The defect of the bone was evidently aseptic. A serious disorder of the continued development of the bone might be apprehended, int. al. of its growth in length. However, the swelling disappeared entirely in a few weeks, and no functional disorders set in. After more than a year skiagraphy (Fig. 2) revealed a somewhat increased density of the tibia diaphysis, but otherwise no visible disorders. The tibia was just as slender and long as on the other side. The cause of the defect of the bone is not ascertained in this case. An infectious complication may no doubt be excluded. Sulfathiazole is but inconsiderably hypertonic owing to which an osmotic effect is not presumable either. A plausible explanation is the intense alkaline reaction (pH 10.8) of sulfathiazole. As a matter of course, a favourable healing of the case described does not, without further notice, defend a recommendation of such a method.

The present writer has not come across any clinical case of

defects of the bone after an injection of an X-ray contrast-medium for the purpose of urography. These investigations have always been carried out with a diluted, isotonic contrast-solution.

The reaction of the bone depends, of course, also on the technique. It is necessary to ascertain that the point of the needle lies in the marrow of the bone, and does not penetrate into the corticalis of the opposite side, and also that it has not such a superficial location as to cause the fluid partly to be deposited subperiosteally, or into Havers' ducts. Several punctures in the same bone may result in a leakage and risks of injuries of the soft parts. In growing bones the epiphyseal line must absolutely be protected from injuries of punctures and injections. On account of this the puncture-needle should always be inserted in such a way as to direct the point from the cartilage of the epiphysis. Complications originating from an erroneous technique of puncturing have been described by TOCANTINS and O'NEILL (1945).

### Own Investigations.

In order to elucidate the resorption mechanism and bone reaction of intra-osseus injections, to a certain degree, the present writer has made up a plan of investigation concerning experiments with animals. The conditions of resorption and pressure in the bone-marrow will be the object of a special publication. As to the reaction of the bone on administering intra-osseous injections, I will here state a few results corroborating the fact that the sphere of application of the method is — as pointed out earlier — limited.

When punctures and subsequent injections are made, it is evident that a great number of the venal sinuses of the bone-marrow are opened. In doing so, a traumatic cavity is formed, which on the X-ray plates taken during the injection of an X-ray contrast-medium appears like a contrast depot around the point of the needle (Fig. 3). The contrast then proceeds through a venal sinus which often has a central location and which attains its rôle as a primary emissary duct in competition with collateral blood-vessels, which accordingly collapse simultaneously. This is a consequence of the special conditions of volume and pressure afforded by the bone-capsule. Venae nutritiae convey the contrast-substance on into the blood-vessels outside the bone, and the excretion through the kidneys occurs as rapidly as after a

direct intravenous injection. Within a few seconds the X-ray plate shows that the contrast in the vessels of the bone-marrow is transported away. Hence it is obvious that, under normal conditions of circulation, the injected fluid contacts the bone-marrow within quite a short time. The question as to whether, during this brief period of contact, the irritating fluid can cause injuries, is in some degree illustrated by the present writer's histologically examined material. This comprises 28 cylindrical bones of rabbits, the femur and the humerus, into which certain fluids of various concentrations were injected. The injections were administered into the lower metaphysis of the femur, and into the upper metaphysis of the humerus. The bones were extracted on different occasions after the injections, and examined histologically. Immediately after their extraction they were put into a 10 % solution of formalin. The histological investigation was carried out by Professor N. GELLERSTEDT.<sup>1</sup> As a colouring method we employed the Congo-cornith methylene-blue stain elaborated by him for the purpose of studying the bone-marrow. In certain cases osseous changes were observed in the X-ray, and these were followed by frequent control X-rays for a time of up to three months.

### Histological Investigations.

With regard to the nature of the injection-fluid, the material may be classified into six groups, in addition to which there is a normal control.

*Normal Control: Bones without a puncture or an injection.* A normal histological picture of the bone, the bone-marrow, and the periosteum (Fig. 4).

*Group 1:* An injection of 20 ml of dextran. Total number: 3. This plasma substitute was chosen in order to obtain some idea as to what effect an exclusive injection of a colloid-osmotically indifferent fluid may have on the bone-marrow. No changes in the caput were to be seen on a bone extracted *two days* after the injection, but a hæmorrhage with a slight shrinking of marrow-cells within a small area around it was visible in one section of the metaphysis. On a bone extracted *four days* after the injection we noticed in the fixation of a muscle near the place of injection a

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<sup>1</sup> I wish to convey to Professor GELLERSTEDT my most cordial thanks for his excellent aid.

slight inflammatory irritation with a proliferation of fibroblasts between the muscle-fibres. Closest to the line of the epiphysis there was a necrosis of a number of marrow-cells. All the changes were quite insignificant. Moreover, the marrow was well preserved. In the metaphysis, a bone extracted *six days* after the injections revealed a slight atrophy of the marrow-cells with an oedema, but otherwise there were no changes.

*Group 2:* An injection of 2—5 ml of a 20 % solution of sodium chloride. Total number: 4. On a bone extracted *six hours* after the injection (Fig. 5) the cells of the bone-marrow in the metaphysis closest to the line of the epiphysis have obviously pyknotic nuclei. Irregularly formed nuclei and nucleus-decomposition (shrink-phenomena?) were to be seen. Within this zone there was even an interstitial oedema. In the epiphysis the marrow was not injured. A bone extracted *nine days* after the injection revealed a normal epiphysis-marrow. Pronounced changes with an oedema and precipitations of fibrin could be seen on the other side of the epiphyseal line. On a bone extracted *eleven days* after the injection no changes in the marrow of the epiphysis were visible, but in the marrow of the metaphysis we could observe a moderate oedema and some increase of connective tissue. There were no acute degenerative changes. A bone extracted *one month* after the injection: no changes of the epiphysis; the marrow of the metaphysis contained an increased connective tissue; it was pronouncedly deficient in cells. A very slight oedema and precipitation of fibrin remained.

*Group 3:* An injection of 2—3 ml of a 40 % solution of glucose. Total number: 3. Bones extracted at the same periods of time as in Group 3 showed mainly the same changes. A bone extracted *one month* after the injection revealed a slight oedema in the metaphysis, but otherwise the bone-marrow was well preserved.

*Group 4:* An injection of 1—3 ml of undiluted sulfathiazole. Total number: 2. A bone extracted *two days* after the injection revealed no changes of the epiphysis, and in the metaphysis there were very slight changes at the epiphyseal line. A short distance further from there, however, the marrow-cells in a region under the corticalis were strongly reduced and the nuclei decomposed. In some sections necroses of the marrow, having a demarcation, were to be seen. In another section an oedema was visible. At a fixation of a muscle we noticed an interstitial oedema and an infiltration of cells as a sign of a slight periostitis. In a bone



extracted *two weeks* after the injection the marrow of the caput was normal, and the marrow of the metaphysis was generally well preserved. A few inspissated hæmorrhages were to be seen. Around these there was a slight atrophy of the marrow.

*Group 5:* An injection of 2—5 ml of an undiluted uroselectan B. Total number: 13. Two bones were extracted *six hours* after the injection. One of them revealed an oedema and a precipitation of fibrin in the connective tissue, a necrosis of adipose and marrow cells. The necrosis comprises quite a large section, even the caput. The other bone revealed a normal caput-marrow, but in the metaphysis we noticed a pronounced distension of lymph-spaces and precipitations of fibrin. The changes appeared within a narrow section closest to the line of the epiphysis. A periosteal vein was the seat of a rather fresh thrombosis. A bone extracted *two days* after the injection (Fig. 6) showed an intensive necrosis of the bone-marrow in the metaphysis. Only a few remnants of nuclei were to be seen left. Besides that, an oedema and a precipitation of fibrin. A bone extracted *three days* after the injection revealed a normal caput-marrow, but a total necrosis in the metaphysis. A bone extracted *five days* after the injection revealed identically the same changes, but in addition to this there was a periosteal swelling and a subperiosteal neoformation of the bone of 1 centimeter's length. Two bones extracted *seven days* after the injection showed on the cross-section of the bone large necroses in the central parts of the marrow with only solitary bone-marrow cells possible to stain. There was a swelling of the periosteum with a proliferation of fibroblasts near the line of the epiphysis. A bone extracted *nine days* after the injection presented changes of a high degree in the metaphysis where a widely spread necrosis was to be seen having cells difficult to stain and a pycnosis of the nuclei. Abundant precipitations of fibrin. An ossifying periostitis of the metaphysis diminishing up towards the epiphyseal line where an increase of fibroblasts could be seen instead. A bone extracted *eleven days* after the injection revealed a normal caput, but in the rest of the marrow there were groups of necrotic cells. A bone extracted *one month* after the injection showed minor necroses in the fatty marrow with a lipophagic reaction. A bone extracted *six weeks* after the injection presented a normal caput marrow and no definite changes in the metaphysis closest to the line of the epiphysis; but further out in the metaphysis we could see small sections having an atrophic, as it were,

shrunk fatty marrow with solitary necrotic adipose cells. Two bones extracted *three months* after the injection revealed multiple small necroses, and in, or around them, a reaction of foreign bodies giant cells (lipophagic granulomas). A number of spongiöse trabeculae are evidently necrotic having extinct osteocytes. A pronounced periosteal proliferation with a chronic inflammatory infiltration of cells and a development of the granulation-tissue. A subperiosteal neoformation of the bones. In the margin of cartilage-bone there were peculiar cystoid cavities filled partly with fresh blood, partly with detrital matter (Fig. 7). The interior of these cavities are lined with a cell-membrane resembling the synovial kind. In the swollen periosteum we noticed a pronounced adventitious proliferation around the vessels, and in certain parts a proliferation of the endothelium of a number of small veins. In certain sections the change has been so great as to obliterate the lumina of the vessels. In the cartilage of the caput there were small circumscribed necroses with a decomposition of the cartilaginous matter.

*Group 6:* An injection of a 20 ml diluted isotonic solution of uroselectan B. Total number: 2. A bone extracted *two days* after the injection revealed no changes in the caput, but in one section of the metaphysis there was a slight atrophy of the marrow within a small sphere. A bone extracted *three months* after the injection showed a normal bone-marrow and a thin periosteum. No changes.

### Roentgenological Changes.

Seven bones histologically examined two weeks after the injection, at the earliest, have also been examined by X-ray during the life-time of the animal. Two of these bones revealed pronounced roentgenological changes, which were observed during three months after the injection. In both cases an injection of 2 ml of undiluted uroselectan B was administered into the lower metaphysis of the femur on the right side, and on the left side a 20 ml solution of the same substance diluted into an isotonic concentration. In one case, *a distinctly pronounced periosteal coating* was, even after a week, to be seen along the right bone, whereas the left side did not present any roentgenological changes (Fig. 8). After an additional week the coatings had increased considerably, and an *incipient decalcification* appeared

*within the metaphyses* (Fig. 9). These changes, which in both cases resulted in almost identical X-ray photographs, later became greater, and appeared like *increased periosteal coatings* and *tenuities* in the metaphyses. After three months the process had been stabilized. *An increase in the breadth of the femur-shaft* was observed (Fig. 10) as well as a *complete defect of the collum femoris*. The caput consisted of a small thin shell. Besides that there appeared deformations and tenuities in the acetabulum — presumably secondary changes. In the total numbers of investigations the left femur revealed a completely normal roentgenography. The histological picture of the right femur is described above in Group 5 (Fig. 7), whereas the corresponding investigation into the left femur is recorded in Group 6.

*Discussion:* The various groups of the material are too small to allow for detailed conclusions. But certain general disorders are inevitable. It can be ascertained that *degenerative changes — often of a high degree — appear after intra-osseous injections of fluids having a hypertonic character*. The appearance of the changes in their initial stages mainly indicates the possibility of *defects from shrinking owing to the osmotic effect of hypertonic solutions*. Moreover, whether the chemical nature of the substance plays a rôle, cannot be definitely determined by the aid of the material given, but the injuries resulting from an injection of the intensely hypertonic iodine contrast-medium of uroselectan B are conspicuously serious, indicating the existence of a *chemical-toxic factor in addition to the osmotic one*. By the dilution of the substance into a blood-isotonic concentration even this element of injury seems to be eliminated. The injuries may be reversible, but in certain cases they develop into such serious defects of the bone and the bone-marrow as are at least in part permanent. In this connection, the development of thrombosis in the blood-vessels, which is of vital importance to a certain section of the bone, would no doubt seem to play a part. Of the solutions practically isotonic with the blood, only sulfathiazole caused injuries worth mentioning, which may probably be attributed to the strong alkaline reaction of this substance.

The intra-osseous method of injection and transfusion is an exceptionally excellent contribution to medical technique. But it has occasionally been recommended for the injection of solutions which must obviously discredit it. By KÖNIG and DRASNAR

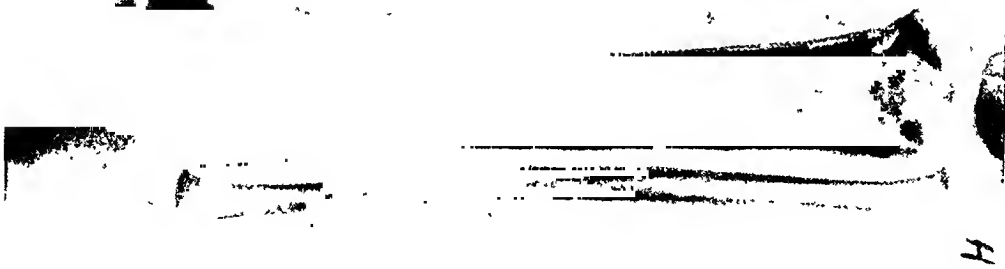


Fig. 1.

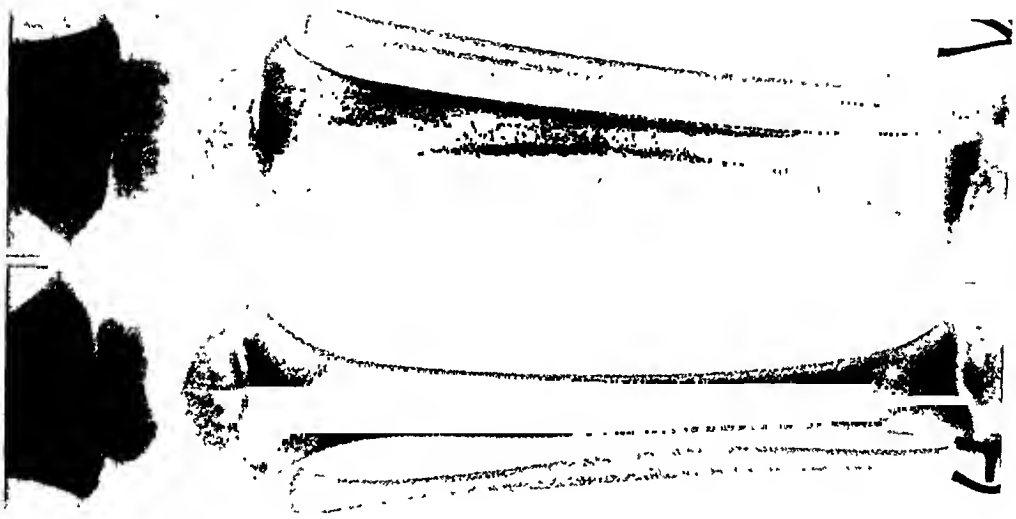


Fig. 2 a.

Fig. 2 b.



Fig. 3.

Fig. 4.

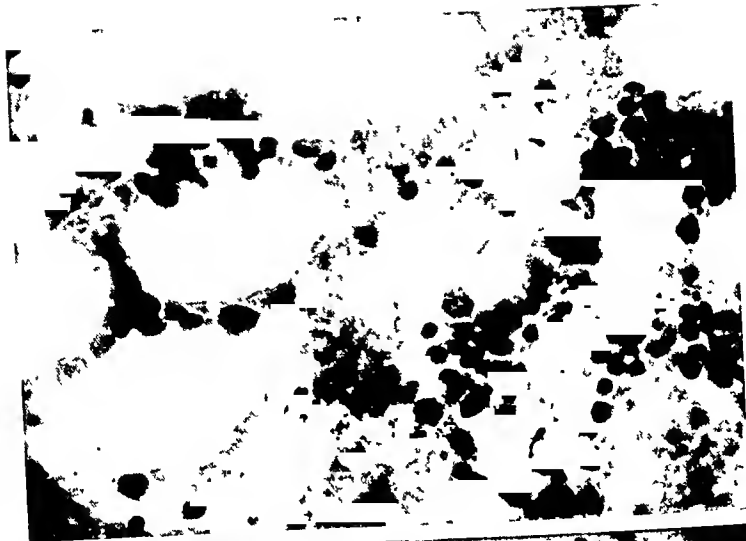


Fig. 5.



Fig. 6.

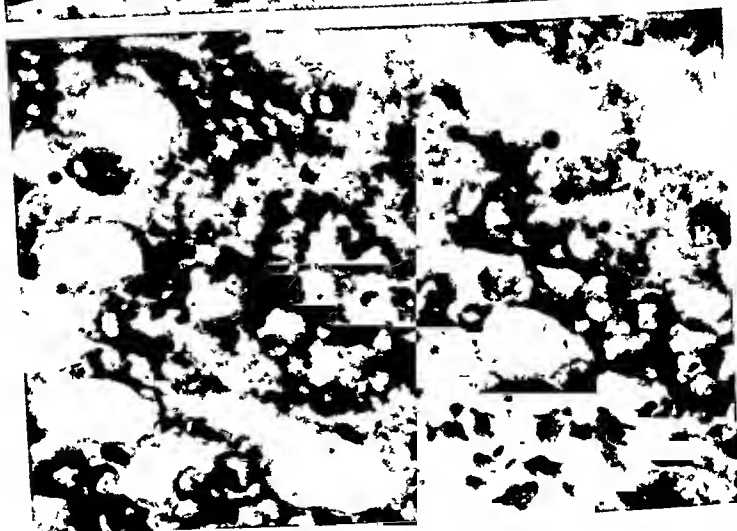




Fig. 8.



Fig. 7.

WALLBÉN: Injuries of Bone and Bone Marrow.



Fig 9



Fig. 10.

(1943) it has even been designated "die Methode der Wahl". We must hold aloof from such a conception. *The intraosseous method should mainly be employed where a venal puncture is difficult or impossible to carry out; and in any case, the solutions to be injected must, besides the requirements placed on an ordinary intravenous injection, even fulfil the demands of an approximate conformity to the osmotic and acid-base conditions of the blood.* Besides that, it is of course necessary to require a faultless puncture technique with scrupulous asepticism and the absence of a septic process.

Owing to the shortage of contrast substances during the war, the present writer's experiments with X-ray contrast-mediums — on man as well as on animals — have been carried out with the best medium available at that time, viz. uroselectan B. As mentioned above, this is considerably hypertonic, and by diluting it into an isotonic concentration the quantity of fluid to be injected becomes approx. 10 times greater than that which is used for a common intravenous injection. If Per-Abrodil, or its synonym umbradil, is employed the situation is more favourable. This medium is less hypertonic, and in the common solution it has a freezing point of  $-2^{\circ}$  C. In order to attain blood-isotonia with a freezing point of  $-0.56^{\circ}$  C., it is only necessary to dilute it with one part to three parts of water. By this insignificant increase of the volume of the fluid the greatest drawback of the method — the great quantity of fluid — has in the main been abolished.

### Summary.

The intra-osseous technique of injection and transfusion has attained to an extensive application during recent years. The limitations of the method, however, have not been sufficiently observed. More or less pronounced injuries of the bone have in several cases come to our notice, and the causes may *int. al.* be found in the irritating effect on bones and bone-marrow of the injected solutions. In order to analyse this effect the present writer has by experiments on animals examined the reaction of the bone and the bone-marrow after an injection of a number of fluids of various compounds and concentrations. The bones have been extracted and histologically examined at different intervals after the injection. The injuries that in certain cases



were possible to point out roentgenologically were followed by control-photographs. The histological investigation reveals degenerative changes of often high degree after injections of hypertonic solutions and strongly alkaline substances. The changes may be reversible, but have in some cases led to distinctly permanent deformations of the bones. The character of the changes speaks, on the one hand, in favour of injuries from shrinking owing to the osmotic effect of the hypertonic solutions; on the other hand, in certain cases in favour of a chemical-toxic effect of the substance injected (iodine). After an injection of solutions isotonic to the blood, the injurious effects mentioned do not seem to appear. The intra-osseous method should mainly be used where a venal puncture is difficult or impossible to carry out; and, in any case, the solutions injected must, besides the requirements placed on a common intravenous injection, also fulfil the demands of an approximate conformity to the osmotic and acid-base conditions of the blood.

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## **The Innervation at the Common Bile Duct-Duodenal Junction from a Surgical Point of View.**

By

CURT FRANKSSON.

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Increasing interest has latterly been shown in nerve operations of different kinds on the abdominal viscera, such as low vagus resections and denervations of the common bile duct. In such operations a thorough knowledge of the course of the nerves is obviously of the greatest importance.

In the present work, the author has tried to ascertain and describe the topographical anatomy of the nerves at and around the junction of the common bile duct and the duodenum, so that the description might be of assistance in surgical operations in these regions.

The microscopical examinations have been made in accordance with directions from Docent BROR REXED, Stockholm. The drawings have been executed by Dr. BJÖRN LINDAHL, Stockholm. The author desires herewith to acknowledge his indebtedness to them.

### **Literature.**

The anatomy of the nerves around the common bile duct-duodenal junction has been described by many authors. The principal works on this subject are enumerated below:

SWAN (1834), in one of his plates, illustrates nerves issuing from the celiac plexus and running on the dorsal side of the common bile duct up to the duodenal wall. They give off branches to the common bile duct and duodenum.

LATARJET, BONNET and BONNOIT (1921) give a thorough description of the nerves to the liver and bile-ducts. They had found thick nerve-trunks issuing from the celiac plexus and running to the right, dorsal to the portal vein. They give off a smaller branch, which joins the common bile duct between the latter and the pancreas. They call it "nerf pancréaticocholedocien". They describe also nerves passing from a plexus round the hepatic artery in the lesser omentum to the duodenum.

MC CREA (1926) made a thorough study of the vagus anatomy. Of special interest here is his description of a nerve-branch from the anterior vagus trunk (vagus sin.), which is given off just below the diaphragm and passes in the lesser omentum towards the porta hepatis. From this branch, offshoots are given off to the pyloric and common bile duct regions. The pyloric branch supplies the uppermost part of the duodenum as well as the pylorus and the adjacent part of the praepyloric region (canalis ventriculi).

RAIGORODSKY (1928) obtained the same results as LATARJET and coworkers.

ALEXANDER (1940) distinguishes between a plexus hepaticus anterior and posterior. The plexus hepaticus anterior is formed by nerve-fibres from the left celiac plexus and the left vagus. It winds round the hepatic artery and forms "nervus pancreaticocholedochus". (What becomes of this nerve is not explained.)

The plexus hepat. post. is formed by nerve-fibres from right celiac plexus and the right vagus. It gives off a nerve which joins the common bile duct and lies on its posterior side. Near the junction between the cystic and hepatic duct the two plexus anastomose. ALEXANDER groups the nerves in the common bile duct wall into a subserous or adventitial, an intramuscular and a submucous plexus.

REICH (1940) found a nerve running horizontally behind the hepatic artery and approaching the common bile duct at its distal part just before it passed in behind the duodenum at the upper edge of the pancreatic head. In some cases the nerve was surrounded by pancreatic tissue.

PERMAN (1935 and 1944) describes a common bile duct nerve given off from the powerful autonomous nerves arising from the celiac plexus. It runs dorsal to the portal vein and is visible at a level with the neck of the gall bladder. It then follows the common bile duct downwards towards the duodenum, lying on its dorsal side to the left of the latter. On its way downwards it gives off

two branches to the common bile duct. PERMAN describes the innervation of the duodenum with a series of nerves from the plexus surrounding the hepatic artery. The nerves pass through the duodeno-hepatic ligament to the posterior aspect of the duodenum. They are also in communication with the direct vagus branch towards the porta hepatis and the pylorus. PERMAN found the vagus branch to the pylorus as described by Mc CREA.

VILLIGER (1917) describes the celiac plexus and its communications. He states that the plexus is divided into a right and a left part, but with numerous communications between them. The splanchnic nerves are stated to be the main communication with the sympathetic trunk, but he notes that there are also other communications with *that trunk through the abdominal aortic plexus*.

WHITE and SMITHWICK (1944) adopt VILLIGER's statements in regard to the celiac plexus. On the other hand they regard that plexus, physiologically, as a unit.

### Material and Technique.

The material consisted of postmortem cases, from which the preparations were taken 8—36 hours after death. Cases which did not show morbid changes within the areas to be examined were selected. Moreover, endeavours were made to obtain preparations which were poor in fatty matter, and thus easily dissected. General studies were made on foetuses, where the autonomous nervous system is relatively well-marked. Detailed studies, in which large preparations are advantageous, were made from adult cadavera.

The dissection preparations were taken and fixed in wire frames in the most natural position possible. These malleable frames were found to be more suitable, as they could be moulded to any desired form, thus enabling the position of the preparation to be changed during the course of the work. The preparations were then immersed in 1% acetic acid (WOROBIEW, PERMAN) for 24 to 48 hours, the longer immersion being required for the preparations which were rich in fat. The action of the acid swelled the surrounding tissue, so that it could easily be removed. Treatment with phenol and picric acid according to the method of PERMAN was tried, but found not to afford any advantage.

The dissections were made directly after the treatment with acetic acid. The whole preparation was dissected in one operation.

This work was carried out partly under water (Worobiew) and with the aid of a dissection microscope (magnification 1 : 60).

The finished preparations were fixed and preserved in 5 % formalin.

For the microscopic examinations, as fresh material as possible was used (8 hours post mortem). The common bile duct with the immediately surrounding tissue was carefully excised (in pieces measuring ea.  $10 \times 3 \times 3$  cm), was mounted on cork sheets and fixed for 36 hours in Stieve's solution. This was followed by paraffin embedding and serial sectioning. The sections were cut in the transverse direction of the common bile duct and were  $5 \mu$  in thickness. Every 25th section was preserved, making 8 sections per mm. The sections were then treated with Azan-staining according to the method of Heidenhain.

This procedure produced distinct slides, in which the connective tissue, muscles, epithelium, nerves and ganglion cells could be clearly distinguished though the finer processes of the ganglion cells were not brought out.

The following description is based on the dissection of 2 fetuses and 10 adults, serial sectioning and microscopic examination of 3 common bile duct preparations, as well as 3 common bile duct denervation operations.

## The Innervation at the Common Bile Duct-Duodenal Junction.

### *The celiac plexus:*

The nerve-plexus on the anterior aspect of the aorta, the bulk of which is situated just below the diaphragm, provides a large part of the abdominal viscera with autonomous innervation. It is termed the celiac plexus and is sometimes described as divided into two branches, one on the right and one on the left side of the aorta. This division, however, is anatomically vague and is scarcely justifiable from a surgical point of view.

The celiac plexus is provided with sympathetic nerve fibres mainly through the splanchnic nerves (major, minor and imus). By the close relations to the abdominal aortic plexus, however, ample provision is made also for other communications with the sympathetic trunk.

Parasympathetic nerve fibres are distributed to the celiac plexus from the vagus dx (= the posterior vagus trunk according to

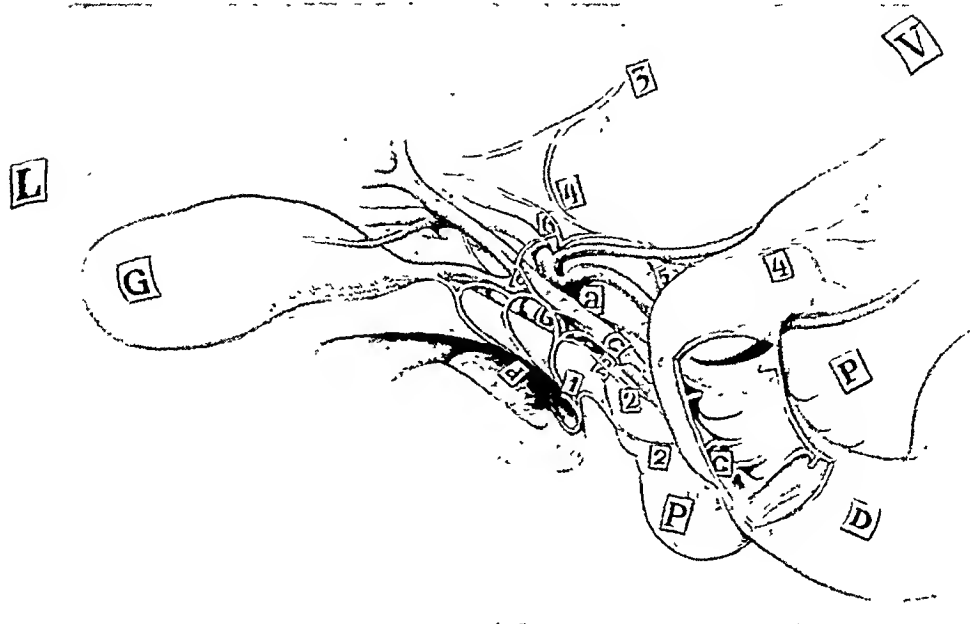


Fig. 1.

Partly schematic drawing of the common bile duct-duodenal junction with surroundings, viewed from the right and ventrally.

Liver (L), gall-bladder (G), duodenum (D) partly opened to show the papilla duodeni Vateri, pancreas (P), uppermost part of the celiac artery with branches (a), portal vein (b), common bile duct (c), foramen epiploicum Winslowi (d), plexus hepaticus dorsalis with three main branches (1), common bile duct nerves (nervi choledochi) (2), ramus porta hepatis nervus vagus sinister (3), ramus pyloricus (4), nervi duodeni (5), anastomosis (6).

MC CREA) through a thick nerve trunk, issuing just below the diaphragm and following the posterior abdominal wall. The vagus sin. (= the anterior vagus trunk according to MC CREA) is in communication with the celiac plexus by nerve fibres running across the uppermost part of the stomach and then following left gastric artery.

### *Nervi choledochi et pancreatici:*

From the part of the celiac plexus lying between the aorta and inferior vena cava, a group of nerve fibres proceeds towards the right. They are usually divided into three main trunks. This group is termed by several authors (such as LATARJET and ALEXANDER) plexus hepaticus posterior (dorsalis). These nerves pass dorsal to the portal vein. They reach the caudal part of the foramen epiploicum (Winslowi) and run there in a ventral direction (Fig. 1 : 1, preparations 1, 2, 3, 4).

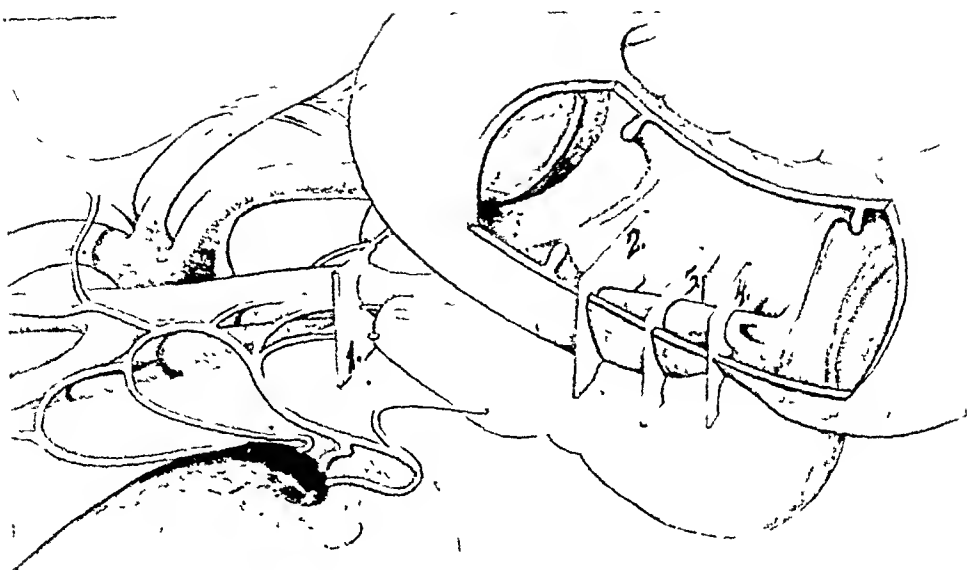


Fig. 2.

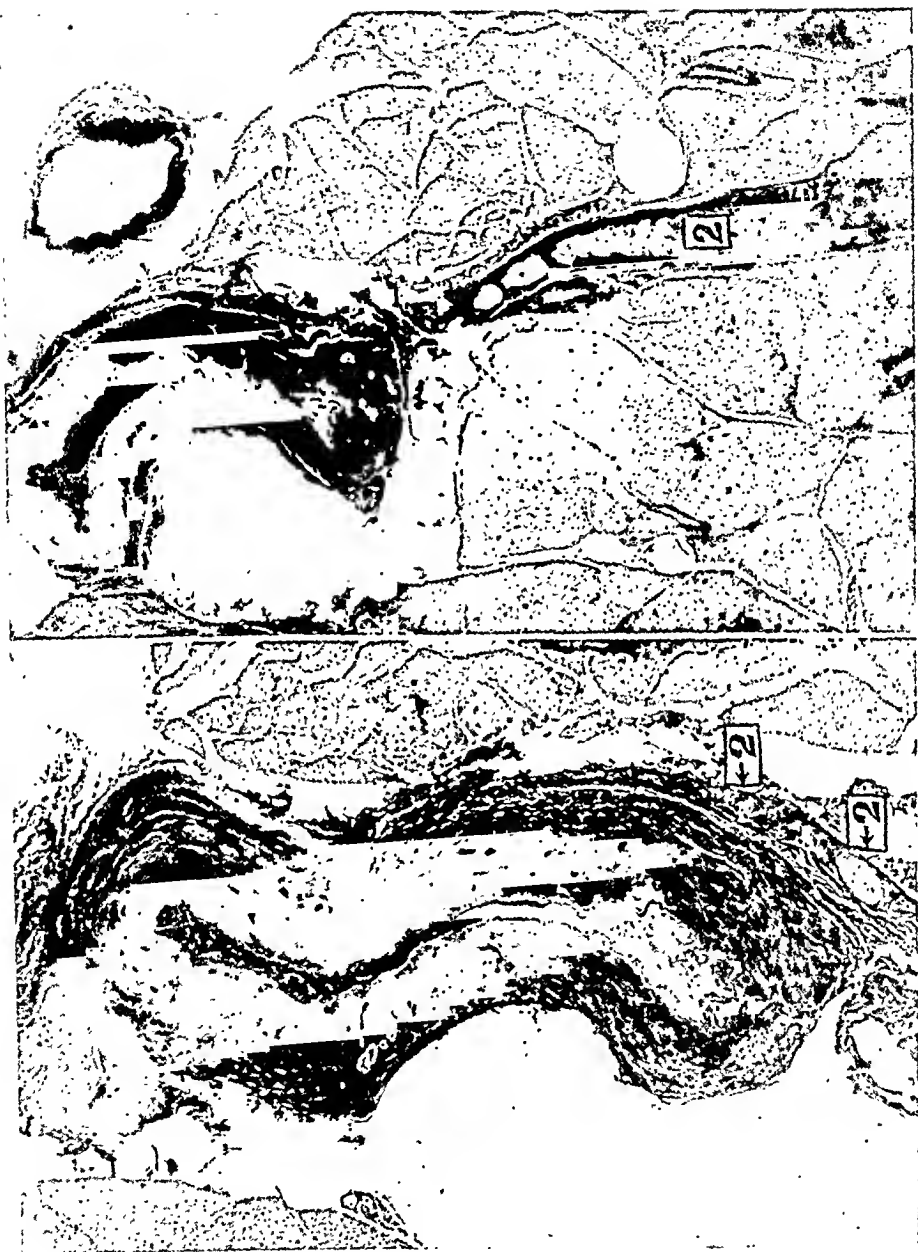
Enlargement of central part in Fig. 1.

The following microphotographs of the common bile duct in cross section were taken at the places marked on the drawing.

- Section 1.* We see two common bile duct nerves (nervi choledochi) (2) in the dorsal part of the preparation.  
(Magnification 1 : 23.)
- Section 2.* A common bile duct nerve (2) which has passed through the pancreatic head joins the common bile duct.  
(Magnification 1 : 15.)
- Section 3 a.* Shows the pancreatic duct (d.p.) in the vicinity of the common bile duct (c) with fine nerve fibres (x) between them.  
(Magnification 1 : 20.)
- Section 3 b.* Enlargement of bundle of nerve fibres (x) which, along the pancreatic duct (d.p.), adjoin the papillary region of the common bile duct.  
(Magnification 1 : 200.)
- Section 4.* Pancreatic duct (d.p.) at its opening into the common bile duct (c). The nerve elements are not brought out in this enlargement.  
(Magnification 1 : 20.)

The thickest branches join the cystic and hepatic ducts, reaching the gall-bladder and liver, respectively. 2—3 finer branches, about a millimetre in thickness, branch off in a duodenal direction and join the common bile duct (Fig. 1 : 2). They also send some offshoots to the pancreas, which moreover receives nerves from the celiac plexus along its vessels.

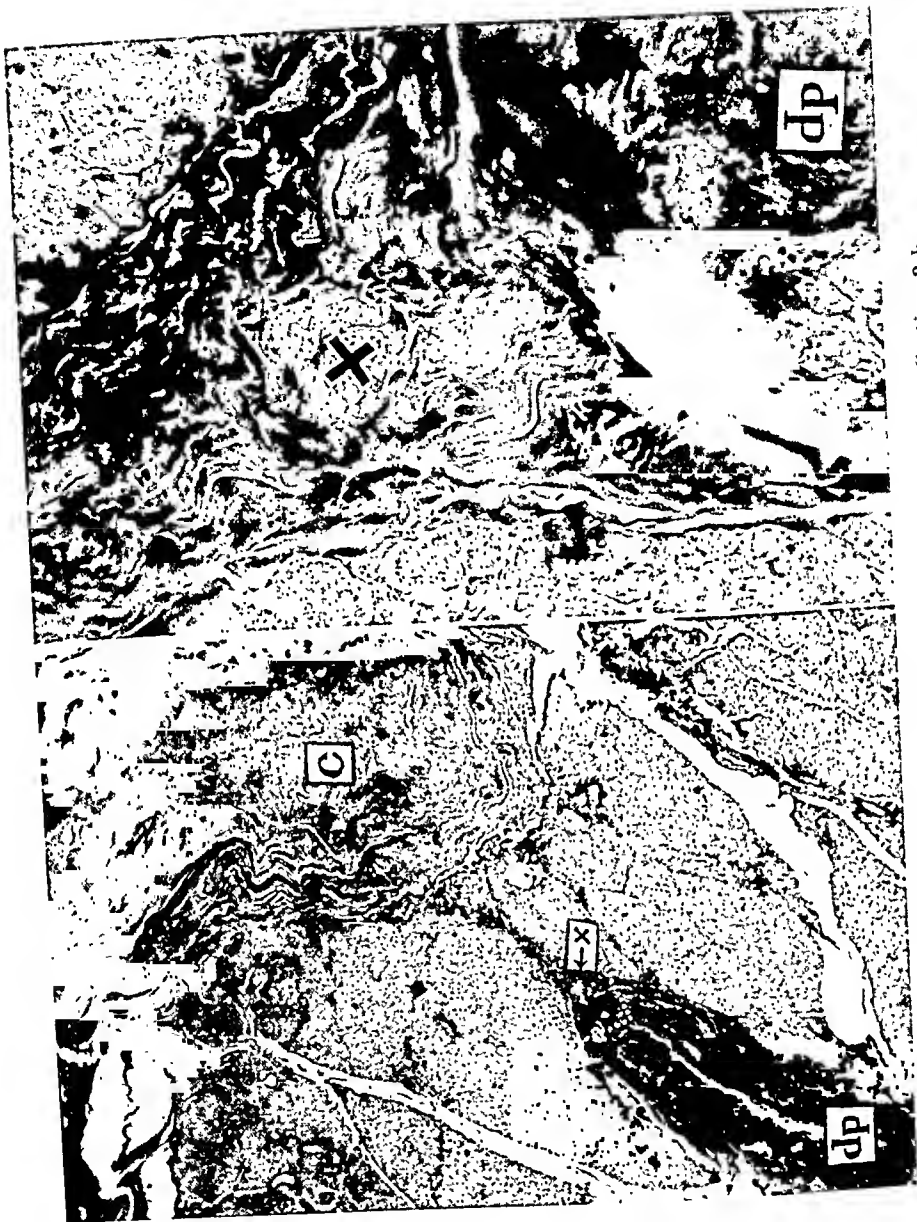
The nerves that join the common bile duct (Fig. 1 : 2) approach the latter from the dorsal side, giving off small branches to it, and are gradually merged completely in its wall. Sometimes one finds a nerve-branch running through the pancreatic head and reaching the common bile duct near the duodenum (Figs. 1 and 2,



Section 2.

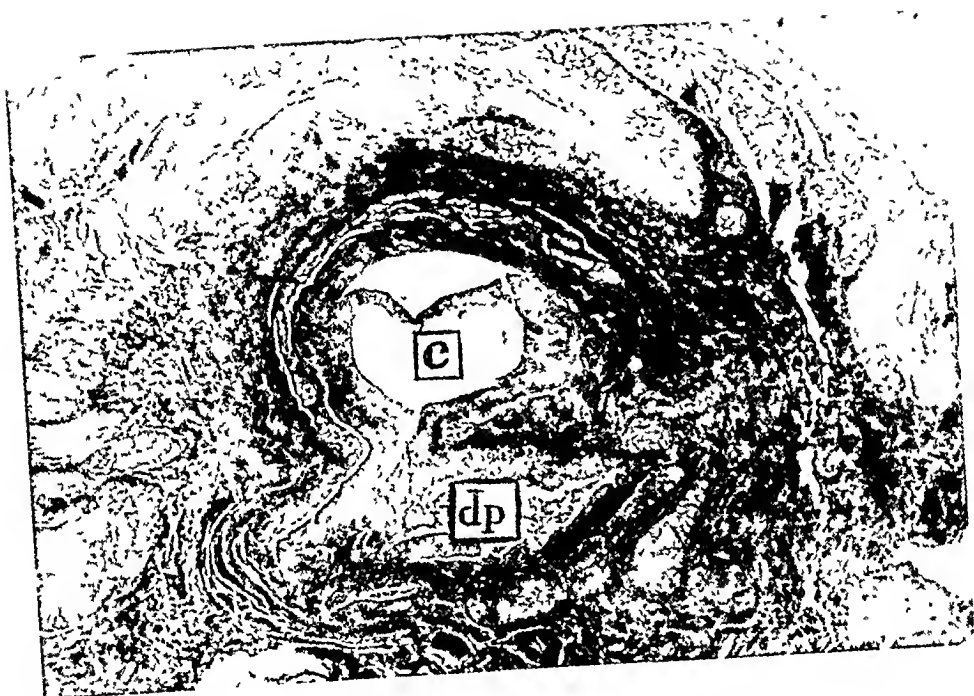
Section 1.





Section 3 a.

Section 3 b.



Section 4.

FRANKSSON: Innervation at Common Bile Duct Duodenal Junction.

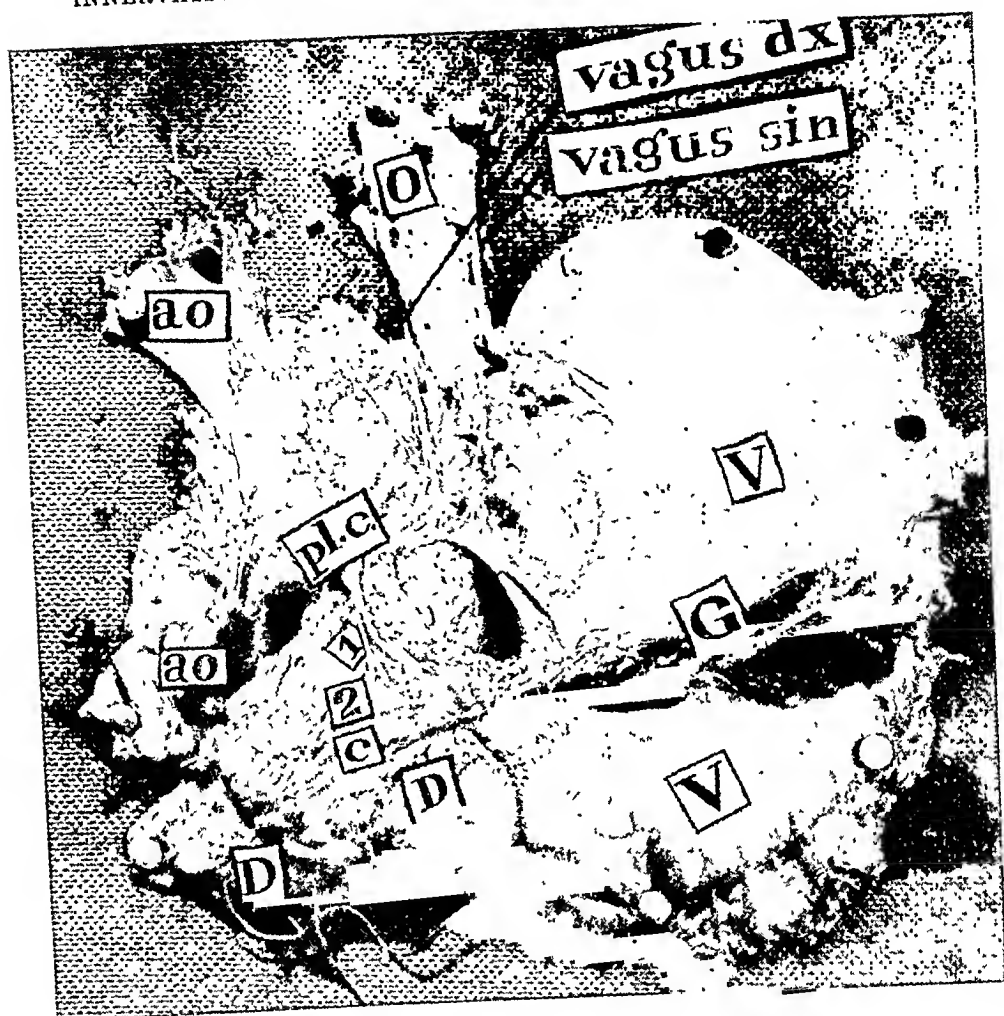


Fig 3 a.

Cholangiogram before denervation. The common bile duct distended. The dye passes with difficulty to the duodenum.

Fig. 3 b.

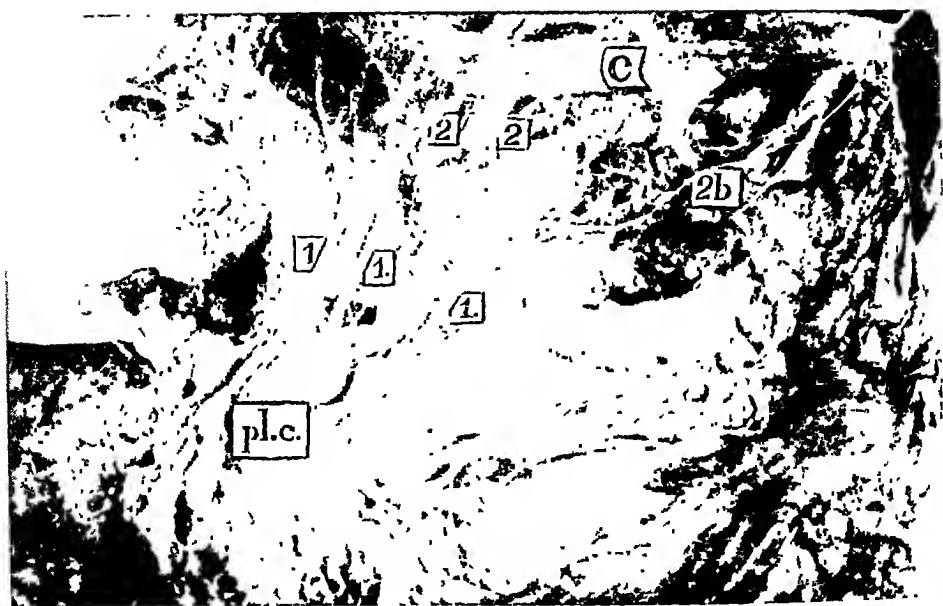
Cholangiogram after denervation. The common bile duct narrower. The dye passes normally to the duodenum.



Prep. 1.

Preparation from a man, aged 40, who had died after an accident (subdural hematoma). Includes oesophagus (o), stomach (ventriculus) (V), duodenum (D) with the papilla exposed, gall-bladder (G), common bile duct (c), aorta (ao), vagus dex. et sin., plexus coeliacus (pl. c.), plexus hepaticus dorsalis with three main branches (1), common bile duct nerves (nervi choledochi) (2). A string threaded through the common bile duct.

section 2). Macroscopically, the nerves could be followed to about  $1\frac{1}{2}$  cm from the place where the common bile duct pierces the duodenal wall; with a preparation microscope for one or two cm further. They are finally merged completely in the common bile duct wall. The nerve fibres have been followed further towards the tip of the duodenal papilla with the aid of a microscope and serial sections (Fig. 2). In the sections we find that the nerves become finer, the nearer they approach the tip of the papilla. Here and there ganglion cells adjoin them. The entire papillary



Prep. 2.

Preparation from a man, aged 28, who had died of ulcerative colitis. Includes the common bile duct (c), plexus coeliacus (pl.c.), plexus hepaticus dorsalis with three main branches (1), common bile duct nerves (nervi choledochi) (2) one branch of which joins the common duct far duodenally after passing through the pancreas (2 b).

area was sectioned and nerves, though very fine ones, were found right out to its extremity. They are distributed in all layers of the wall.

Under the microscope, a few fine nerves which, after passing along the pancreatic duct, reach the papillary area, can also be observed (Fig. 2, section 3). Through these nerve fibres and the pancreatic nerves, there is a slender communication between the papillary area and the celiac plexus.

No direct communications with the nervous apparatus of the duodenal wall have been observed, though, with the histological methods adopted here, very fine communications of this nature cannot be completely ruled out. The well-delimited nervous apparatus detected indicates, however, that such communications with the duodenum can scarcely be of any great importance.

A division into different nerve plexus within the common bile duct wall (adventitial, intramuscular, submucous), as reported by ALEXANDER, has not been observed.



Prep. 3.

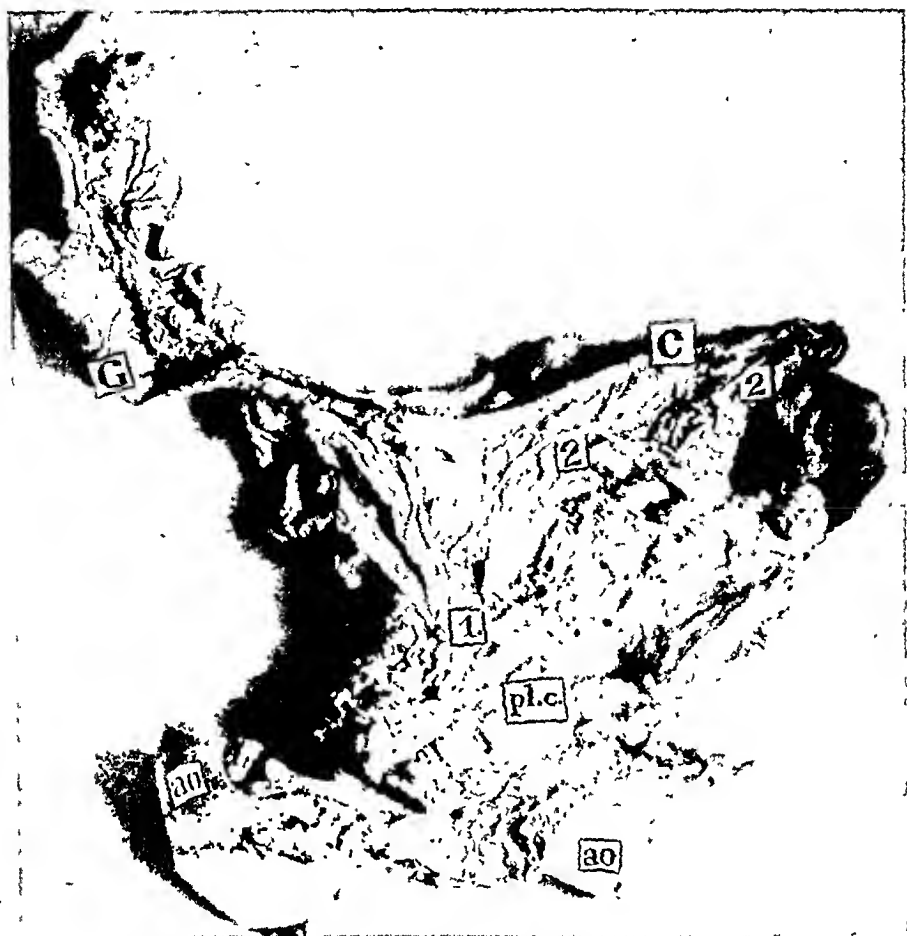
Preparation from a man, aged 40, who had died of uremia. Includes the same nerves as prep. 2. All the common bile duct nerves (nervi choledochi) join the common bile duct at an early stage.

### *Nervi duodeni:*

From the celiac plexus there winds round celiac artery—  
hepatic artery, a nerve-plexus [plexus hepaticus ant. (ventralis)  
according to ALEXANDER and others] which, at the triangle formed  
by right gastric artery — common bile duct — duodenum, sends  
3—4 nerve-branches towards the dorsal side of the duodenum.  
These nerves anastomose with the direct vagus branch to the porta  
hepatis (Fig. 1 : 4 : 5). The duodenum is supplied with nerves  
from the celiac plexus also along the blood-vessels (a. pancreatico-  
duodenalis and a. gastroeiploica dx).

### *Nervus pyloricus:*

About two cm below the diaphragm, n. vagus sin. (the anterior  
vagus trunk according to MC CREA) gives off a branch which,  
through the lesser omentum, passes towards the porta hepatis  
(Fig. 1 : 3). A minor part of this branch bends off towards the



Prep. 4.

Preparation from a woman, aged 74, who had died of cancer lingue. Includes the same nerves as prep. 2. The common bile duct cut open. Plexus hepaticus dorsalis consists of two main branches.

pyloric area (4), where it ramifies, supplying the uppermost part of the duodenum (5), the pylorus and the adjacent part of the praepyloric area (4). The nerve fibres to the said part (4) could be followed for about 3 cm towards the cardia, where they meet the nerves coming from the upper end of the stomach. No actual communication between them has been observed, but they overlap in distribution.

#### *Anastomoses:*

Near the junction of the cystic and hepatic ducts, there are some fine anastomoses between the common bile duct nerves and

the nerve fibres winding round the hepatic artery (Fig. 1:6). (They correspond to ALEXANDER's anastomoses between plexus hepaticus ant. and post.)

## Discussion.

*Celiac plexus:* To regard this plexus as divided into a right and a left part is scarcely warranted from a surgical point of view. It would be more correct to regard the celiac plexus as a unit.

Besides the splanchnic nerves, the celiac plexus has several communications with the sympathetic trunk through the abdominal aortic plexus.

### *Nervi choledochi et pancreatici:*

SWAN, LATARJET et alios, RAIGORODSKY, ALEXANDER, REICH and PERMAN describe a nerve which runs along the dorsal side of the common bile duct. The description ends at the duodenal wall.

No statements have been found regarding nerve communications along the pancreatic duct.

The present investigation has shown that there are several nerve trunks passing along the common bile duct in duodenal direction (nervi choledochi), and that more than one of them reach the nerve mechanism of the duodenal papilla.

A nerve communication from the papillary region along the pancreatic duct (nervi pancreatici) and the pancreas to the celiac plexus has moreover been observed.

ALEXANDER's division of the nerves of the common bile duct wall into different plexus (submucous, intramuscular, adventitial) has not been verified. For this purpose, however, a different histological technique is presumably required.

### *Nervi duodeni:*

The results of this investigation correspond in essentials with the findings of SWAN, LATARJET et alios, RAIGORODSKY and PERMAN.

### *Nervus pyloricus:*

MC CREA and PERMAN describe this nerve as innervating the uppermost part of the duodenum and pylorus.

Similar conditions have been shown by this investigation. The finer nerve fibres were followed on the praepyloric area right up



to the place where, about 3 cm from the pylorus, they meet the nerves coming from the upper end of the stomach.

#### *Anastomoses:*

The same anastomoses as those described by ALEXANDER at the junction of the cystic and hepatic ducts have been found.

### **The Nerves at the Common Bile Duct-Duodenal Junction from a Surgical Point of View.**

Of the above-described nerves, n. pyloricus and the common bile duct nerves (nervi choledochi) are surgically of special interest.

#### *N. pyloricus:*

The praepyloric area (canalis ventriculi) is known to have a powerful motor apparatus and is considered to play an important part in the emptying of the stomach. Its acid production, on the other hand, is of minor importance.

The impulses through the pyloric nerve are consequently important for the emptying of the stomach, whereas they are believed to have less effect on the production of acid.

A thoracic vagotomy completely cuts off the vagus supply to the stomach. In the case of an abdominal vagotomy the vagus branch to the porta hepatis, and thus also the pyloric nerve, can be preserved. In the latter case the acid production of the stomach may perhaps be reduced, but the motility in canalis part — essential for the emptying of the stomach — will be retained.

If section of the pyloric nerve is desired, it is, as pointed out by LATARJET and MC CREA, quite accessible just outside the pylorus. The origin of the pyloric nerve, the direct vagus branch to the porta hepatis, is in fact easily accessible in the lesser omentum a few cm below the diaphragm. It is almost always seen in abdominal vagus resections.

#### *Nervi choledochi et pancreatici:*

The foregoing description shows that the papillary region of the common bile duct is innervated in two different ways, by pancreatic nerves (nervi pancreatici) and by common bile duct nerves (nervi choledochi).

The communication with the pancreas is extremely slender and under normal conditions seems to be of little importance. If,

however, the other nerve communications to the papillary region are destroyed, it is conceivable that the communication with the pancreas might assume greater importance. To attack it surgically seems nevertheless to be out of the question at present.

The common bile duct nerves are certainly the normal channel for the transmission of impulses to the papillary region. As shown above, they are rather scattered at the periphery. They are most closely concentrated after they have passed the portal vein at the caudal part of the foramen epiploicum (WINSLOWI). See fig. 1 : 1 : 2, preparations 1—4.

REICH (1940) and PERMAN (1944) have described a technique for denervation of the papillary region of the common bile duct (as a remedy for spasm in the sphincter Oddi). As the most suitable way of finding "the common bile duct nerve", they suggest that the operator should enter from a ventral direction between the portal vein and the common bile duct. Here the main nerve-trunks from the celiac plexus are congregated. The smaller branches of the common bile duct nerves may sometimes be quite accessible. In cases where one has a branch running rather far dorsally, and which perhaps also passes through the pancreatic head, it will scarcely be accessible in the way indicated by REICH and PERMAN.

For denervation of the papilla duodeni (Vateri), it is proposed that the common bile duct nerves should be exposed and resected at the caudal part of the foramen epiploicum (Winslowi).

The duodenum must be mobilised at the part corresponding to the common bile duct area. The common bile duct is retracted to the left and the peritoneum is divided along the caudal part of the foramen epiploicum (Winslowi). Any subserous fat is removed. The thick nerve-trunks from the celiac plexus (plexus hepaticus dorsalis) as well as the common bile duct nerves are then exposed. A picture similar to that shown in Figs. 1 and 2 and to preparations 1—4 is then obtained.

The main branch of the dorsal hepatic plexus, situated nearest the duodenum, is resected, as well as all the common bile duct nerves. The resection is made as close as possible to the celiac plexus and the common bile duct.

This procedure is perhaps technically more difficult than that recommended by REICH and PERMAN, but, on the other hand, yields more reliable results.

## Technique in the Denervation of Papilla Duodeni (Vateri).

The technique is indicated by the description of the following case:

The patient was a woman, aged 38, who 4 years previously had undergone cholecystectomy. She had been suffering for two years from severe gallstone-like attacks. They recurred about twice a week.

Operation (M—n). Percain + narkotal. Pribram section. The common bile duct was easily exposed. Cholangiography. Considerable resistance was encountered on the injection of the dye, which ran out into the duodenum in a narrow stream (Fig. 3 a). Flexible bougies No. 14—16 were passed without any noteworthy obstruction. The pressure in the common bile duct varied directly with the depth of anesthesia. Denervation of the papilla was resolved upon. Mobilization of the duodenum according to the method of Kocher, mobilization of the whole pancreatic head and division of the peritoneum at the caudal part of the foramen epiploicum (Winslowi). The nerves to the papilla, common bile duct and liver were exposed. All the nerves except the uppermost of the main branch were resected (see preparation 2). The duodenum was replaced and fixed with serosa suture. Renewed cholangiography showed normal passage to the duodenum (Fig. 3 b).

The patient since the operation (four months ago) has been free from pain.

### Summary.

The present paper is concerned with a detailed study of the innervation at the common bile duct-duodenal junction, with the object of providing an anatomical basis for surgical operations in this region.

The study was made on postmortem cases that did not show morbid changes within the area examined. The course of the nerves was studied macro- and microscopically.

The celiac plexus is regarded as a unit having several communications with the sympathetic trunk.

The papilla duodeni (Vateri) is innervated mainly by the common bile duct nerves, which run from the dorsal hepatic plexus along the common duct. Fine nerve communications, *nervi pancreatici*, have however, been found along the pancreatic duct.

The nerves to the upper part of the duodenum and pylorus are described.

The possibilities of denervating the papilla duodeni (Vateri) are discussed and a suitable technique for the purpose is described.

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## A New Plate for Osteosynthesis.

By

HENRIK SÖLLAND.

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In recent years there has been a growing tendency towards operative treatment of fractures. The reason is that this method is convenient and reliable, since anatomical reposition is most often attained at once, and that by means of wire, screws, plates, rivets or nails a more complete fixation is also secured. The treatment is thereby finished and the after-treatment is generally simple and convenient, whereas bloodless therapy often entails several repositions, readjustment of plaster-bandages and long-continued traction and confinement to bed, while the final result is not always quite satisfactory. The operative treatment therefore offers many advantages, not the least important of which is an early mobilisation of the limb. The most typical example is the riveting employed in case of *fractura colli femoris*.

Transverse fracture of the tubular bones is a stabile fracture and here reposition is often successfully effected. But it frequently happens that the reposition is difficult or impossible, for instance, in case of *fractura antebrachii*, and the result will then be only moderately satisfactory without operation.

For fixation of transverse fractures of short oblique fractures it has been most usual to employ screws, wire or Lane's plate. Each surgeon will find his way to the method he thinks best.

Lane's plate has in course of time come to have fewer adherents, partly because newer appliances have come more into fashion and partly because the results attained with Lane's plate were not satisfactory in every man's hand, which, moreover, is also

true both for screws and wire. Mechanically, the plate undoubtedly gives the best fixation, with the exception of marrow-riveting, which I believe demands more special indication and which is by no means every man's method. Technically the plate is also the easiest to operate with. But the necessary condition for the use of a plate is that it yields equally good results as other modes of fixation.

Many surgeons are deterred by the relatively large size of the plate in comparison with a thin wire or single screw, and many have thought that the large foreign body which the plate represents might be the cause of the retarded healing or the failure to heal which is now and then encountered. Nevertheless, the same surgeons have little hesitation in using the massive rivet for *fractura colli femoris*, or the solid marrow-nail. I believe that it is not the size, but the construction of Lane's plate that is the cause of many of the bad results.

It must not be forgotten that transverse fractures heal more slowly than oblique fractures, partly for the reason that the former are often direct fractures, involving injury to the soft tissues and the periosteum. But apart from this, there are many things which hinder or promote callus-formation. Disregarding ordinary diseases, we find that abnormal mobility, and then especially flexion, rotation and extension, have an inhibitive effect on the formation of callus. On the other hand, pressure of the fractured bones against each other, when no other movement can take place, seems in most cases to act as an incitement.

The time of healing for operated and non-operated fractures has been investigated by HARBITZ in material from Ullevål Hospital. He finds that the time of healing is the same for operated and for non-operated crural fracture. HJÖRDIS JØRGENSEN has tested a number of metals and alloys and finds that the healing is first of all dependent on the property of the metal to become incorporated without reaction, and that chromo-vanadium steel alone fulfils this requirement.

I believe that, mechanically, the plate gives the best fixation and is technically easiest to work with. But when one has worked a good deal with Lane's plate it will be found that there are certain disadvantages which soon manifest themselves. Even if the reposition is anatomically correct before fixation of the fracture, yet we will in many cases find a small diastasis when the screws have been tightened up. It is then too late to rectify this,

unless we proceed to repeat the whole operation, to move the plate and then run the risk of having the same defect again. Further, we are dependent on four holes for the screws, and it may happen that for that reason the plate cannot be fixed at the most suitable place, because one of the holes comes too near to the fracture line or over a fissure or the like. And now and then

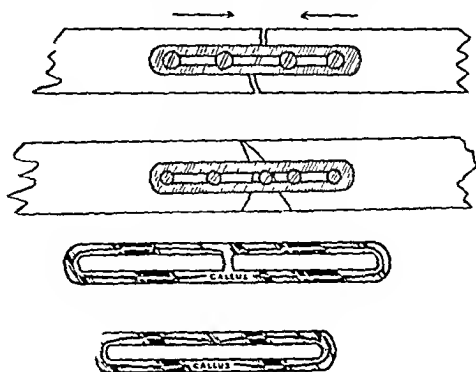


Fig. 1. The new plate.

it happens that a screw breaks off and perhaps the plate may have to be moved.

These defects in Lane's plate gave me the idea of a plate of which the construction seems to eliminate the above faults and which has otherwise a number of advantages. This plate has now for some years been employed in several hospitals.

As the illustration shows, the holes are replaced by a slot into which can fit the ordinary screws used for Lane's plate. The screws are usually made in four sizes, of graduated thickness and length. The choice of the screw to be used is made according to the circumstances in the individual case, irrespective of the size of the plate. It is important that the gimlets used for boring shall be adjusted to the thickness of the screw and shall be numbered, so that gimlet No. 3, for example, makes a hole which will easily admit screw No. 3 and also give it a good hold.

The plate is made of stainless steel and is somewhat thinner than Lane's plate. The steel is also somewhat softer and the plate can therefore, when it is found expedient, be bent to adapt itself to its position without breaking. For example: fixation of subtrochanter osteotomy etc.

The purpose was to secure a stable fixation, which at the same time allowed the ends of the fractured bones to glide towards

each other after fixation. This is attained in the manner that the screws in one fragment are not fully tightened up or else are loosened by giving them a quarter turn. Consequently one fragment will be able to move freely in the fissure, being guided by the two screws. The slight loosening of the screws necessary for this gliding movement is not so great as to permit of abnormal mobility, such as lateral flexion or rotation.

The fractures here concerned are such as have a tendency to contraction. The muscular traction will ensure that the ends of the fractured bones will always be in intimate contact, even if there should come a secondary absorption thereof. This will be revealed on the radiograph as a measurable gliding of the two loosened screws in the slot in the plate. The absorption is seldom so great that the gliding movement is measurable, but the intimate contact will exist and there will be a certain degree of friction, with consequent incitement to callus formation. If the position attained is not satisfactory one can, even when the plate is fastened by all four screws, continue to improve the reposition, so as to ensure an anatomically correct reposition, if that is at all possible. A primary diastasis is for this reason also precluded.

In my opinion the main defects in Lane's plate will in this way be eliminated. There is never any risk of a primary diastasis, which Lane's plate would maintain undiminished, and the fracture surfaces will always be in intimate contact, even if secondary absorption should occur, while Lane's plate permits of no closer contact than that which exists when the screws are tightened up.

The plate has also several other advantages. We are more independent in the choice of the places at which we wish to insert the screws and can avoid coming too near to the fracture line and likewise evade fissures. Should a fragment have been evulsed, it can, if found expedient, be fixed by a 5th screw and the fracture thus be converted from comminuted to simple type. Should a screw break off, we can bore beside it. Likewise if one should happen to bore aslant. The plate can also to a certain degree be bent so as to adapt itself to its position, without losing its power of fixation. Finally, for the satisfaction of those who think that the weight of the plate is of some importance, it may be mentioned that the new plate will be about 20 per cent lighter than Lane's and in many cases the purpose can be attained with a smaller plate of my type, precisely because the screws can be inserted at whatever place we wish.



I shall not enter into any evaluation of the different methods of fixation. As already mentioned, each operator will find his way to a method which he has mastered and is more or less satisfied with. Riveting through the marrow must no doubt be deemed the most complicated procedure and makes great demands as regards technique. Suturing with wire is technically easy, and it also allows of keeping the fragments in intimate contact, but gives unreliable fixation. Screws will ensure better fixation than wire, but will otherwise be just as "stiff-boned" as Lane's plate!

A plate of my type provides good fixation and contact. Technically it is so easy to work with that the immediate result of the operation must be satisfactory, even if the operator has no great technical skill or has only occasionally had practice in operative treatment of fractures. The new plate should therefore satisfy all the demands that can be made upon a good operative method of fixation.

At the Möre and Romsdal County Hospital we have in the past year operated and fixed with Söiland's plate 10 transverse fractures, whereof 3 are still under after-treatment.

Apart from one case, which shall be described below, the time of healing varied from 6 weeks (humerus fracture in a boy aged 12 years) to 16 weeks for a complicated crural fracture, where primary osteosynthesis was performed.

Measurable gliding to the extent of 2—3 mm is found in two cases, while in another two cases there can be distinctly seen a slight gliding movement, which cannot with certainty be measured in millimetres. Except in the case below described, the plate has not been removed. The axial conditions observed at the conclusion of the operation have remained unchanged. The callus is always of moderate size and is most often found to have a spool-like, circular form.

The case I shall here describe stands in a class of its own, but it seems to provide a justification of the use of the new plate and to show all its advantages in one sum.

The patient was an 18-year-old boy, who two years earlier had osteomyelitis in the left femur and had been radically treated by chiselling. The wound had been sutured and it healed by *per primam*, but there was very little bone left in the lower part of the femur, so that it took over half a year before he could put weight on the limb without support. The thigh-bone was then converted into a solid stick, without any suggestion of marrow, and the lower part was somewhat reduced in thickness. On the 29/11 1944 he fell when walking



Fig. 2. Immediately after the operation. Fracture line hardly visible. Note position of screws.



Fig. 3. Five weeks after operation. Resorption and subsidence, the extent of which can be distinctly measured by the position of the screws.



Fig. 4. Eleven weeks after operation. Softening, resorption and subsidence further increased. Axial conditions continue to be good



Fig 5. Eight months after operation. Solid umon, with full ability to bear weight

on slippery ground and sustained a transverse fracture of the femur at the thinnest part, a couple of handbreadths above the knee. As it was deemed difficult or impossible to replace and retain the fracture by traction or other bloodless treatment, surgical reposition and fixation by Söiland's plate were carried out immediately after his admission. The limb was then placed in plaster. Radiograph fig. 2 shows the situation immediately after the reposition. The fracture line is almost invisible.

One might expect a revival of the previous inflammation after the severe trauma, and a couple of weeks later there came a little secretion which soaked through the plaster. But the temperature was unaffected and he had no pains. After 5 weeks the plaster was removed. An old fistula had broken out on the inner side of the thigh, but it gave little secretion. The radiograph taken at that time (Fig. 3) shows that ends of the fractured bones have glided nearer together, about 1.5 cm, and there is seen some dispersed periosteal callus. Plaster is again applied, with a window over the fistula.

As the secretion persisted and the radiograph (Fig. 4) showed that the plate had played out its rôle, it was removed 11 weeks after the operation. From this picture it can be seen that the gliding movement has continued on account of absorption and that the screws have by degrees come into the soft, non-calcareous tissue and have also become displaced in relation to each other. The three upper screws were found to be quite loose, while the lowest one had to be screwed out.

The secretion now decreased, but did not cease entirely until after the lapse of another two months, when there came out a couple of small chips of bone.

Seven months after the operation full stability was attained, but he was not allowed to put any strain on the limb or walk on it until between 8 and 9 months after the fracture. The radiograph (Fig. 5) then shows solid union, with an extra bridge of bone at the back.

This case demonstrates almost to superfluity the secondary gliding movement which the plate allows to take place. And the intimate contact that was maintained the whole time has no doubt contributed to the comparatively rapid healing of this special type of fracture, in spite of a moderate recrudescence of the infection. It is difficult to imagine that any other mode of fixation could have given so good a result in this case. Riveting through the marrow was out of the question, since no medullary cavity existed. Screws and wires would after some few weeks have lost all power of fixation and of axial guidance, while Lane's plate would have maintained the secondary diastasis until the softening process had reached the outer screws. There would then no doubt have come a rapid sinking of the bone with danger of axial break, whereas the new plate during the whole time of absorption had control of the axis — until the fractured bones were relatively firmly knit.

I believe that the case demonstrates the chief properties of the plate. Firstly, the anatomical reposition, which is easily effected,

and, next the secondary gliding movement, which is particularly marked in this case, but which is seen in more or less degree in all fractures and which seems to have importance for a normal and rapid healing.

### Summary.

The author believes that a plate has many advantages as fixation method for transverse fractures, but he thinks that Lane's plate, owing to its construction, is not satisfactory. He has therefore designed a plate which has a continuous slot instead of holes for the screws. Thereby are attained the following advantages:

1. The reposition can be "touched up" after the plate and the screws are firmly fixed, whereby an anatomical reposition will always be attained before the wound is closed.

2. During the process of healing the broken bones will glide towards each other along the slot — guided by the screws — and there will at all times be intimate contact at the site of the fracture. This will in most cases be a good incitement to callus formation and the healing will take place with relative rapidity, while the danger of pseudarthrosis will be slight.

The plate is lighter than Lane's and is to a certain degree pliant, so that it can be adjusted to fit into its position. And as the place for insertion of the screws can be freely chosen, one can avoid coming into fissures, while no complication will be created, even if the holes are bored a little crooked or if a screw should break etc.

A case is described in which the ends of the fractured bones glided 2 or 3 cm during the process of healing, which seems to have taken place rapidly under otherwise unfavourable conditions, and it must therefore be supposed that the gliding movement has been of great or even decisive importance for the good result.

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From the County Hospital, Ludvika  
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## Comparison between Clinical and Histological Diagnosis in Toxic and Atoxic Goiter, with Special Regard to Kraus's Staining Method.

By

SVEN DAHLSTEDT,

Ludvika.

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There is no reason for going into the many theories concerning the etiology of struma. This paper will only deal with the connection between the clinical symptomatic picture and the histological changes which occur in the operatively removed gland.

In addition to the symptoms determined by the size of the gland and its mechanical position, struma presents many symptoms varying from myxedema to the highest degree of thyrotoxicosis.

There are no cases in this material of hypofunction to any marked clinical degree. Therefore only clinically toxic and clinically atoxic strumas will be dealt with separately in this paper. But as the line of demarcation between these forms cannot be sharply defined, a group of uncertain cases must naturally arise. The same conditions apply to the histological diagnosis where it is impossible to define the transition between toxic and atoxic goiter. A clinically atoxic goiter is present when only an enlargement of the thyroid and the stipulated mechanical symptoms exists. Moreover one finds general symptoms in the toxic form. Diagnosis is therefore made from both the subjective symptoms and objective signs which, however, need not all exist simultaneously. The most important are: loss of weight, perspiration, nervousness, gastro-intestinal disturbances, palpitation of the heart, tremor, tachycardia, the frequent appearance of the classic eye symptoms and increased metabolism. Certain difficulties

can arise in assessing the value of the thyrotoxic symptoms. Palpitation of the heart and shortness of breath can depend on pressure from a large atoxic struma with constriction of the trachea. Other diseases such as tuberculosis, myocarditis and post infectious conditions can produce similar symptoms and simulate toxicity. The fact that the climacterium often presents symptoms from the nervous, especially the vasomotor system, which can easily be mistaken for toxicity, is very important. One very often finds that a toxic struma gradually develops from one that is atoxic, often in connection with the climacterium. To a large extent, the cases under review consist of just such goiters which for many years, have not caused the patients any subjective trouble but have gradually become toxic. Consequently the line of demarcation between toxic and atoxic is difficult to define especially as, in individual cases, at all events, changes in the intensity of the toxic state often arise. It has been considered unnecessary to draw up a table of the clinically uncertain cases as a study of the other tables immediately discloses them.

The histological examinations of the operative specimens have been carried out by the Pathological Institute, Upsala University.

The basis for the patho-anatomical diagnosis, toxic goiter, lies in the usual changes in the microscopic structure which, briefly, are as follows:

1. Follicular: irregular shape, different sizes more or less collapsed with papillary excrescences, within certain regions, solid epithelial formations without follicles.

2. Epithelial: hyperplastic with polymorphous nuclei.

3. Colloidal: scanty, thinly liquid, vacuolated, specifically stainable according to KRAUS (see below), almost completely absent in serious cases.

4. Interstitial tissue: rich in bloodvessels, lymphocyte aggregations and lymphoid follicles.

The above description applies first and foremost to the genuine Basedow's struma. In the very common nodulous toxic struma the histological picture — as a rule more indefinite from case to case — is very changeable.

Even with the histological diagnosis it is naturally the intermediary forms which cause diagnostic difficulties. A certain variation of the normal picture must be expected. Further, every part of the gland is not microscopically examined. Exceptionally

large strumas thus may hide parts which have another picture than that examined by the pathologists.

A special method of staining the colloid in goiter-slides, which was discovered in 1914 by KRAUS, has been used as the routine method for many years at the Pathological Institute at Upsala. This method is partly the basis of the histological diagnosis in these cases and it will therefore be mentioned in more detail (see footnote 1).

KRAUS shows that staining with polychrome methylene blue, differentiating with a solution of tannin and restaining with acid fuchsin gives a staining reaction in the colloid by means of which the character of the colloid can be read. He differentiates between three types of colloids.

1. The fuchsinophile stained blue in the preparation and found predominant in the normal thyroid gland and in atoxic goiter.

2. The fuchsinophile pale to yellow red in the preparation, found in toxic goiter.

3. The tannic acid fast, dark violet in the preparation, found as in 1.

According to KRAUS, a harmonious function of the thyroid gland is depending on a correct action of these three types of colloids. A toxic condition exists when the fuchsinophile colloid is predominant. KRAUS considers that the tannic acid fast colloid has significance as an antitoxic factor. Even if this theory about three chemically different colloids is improbable or at least unproven, there still remains, however, the fact that the staining properties of the colloids show a strong relationship to the clinical picture in that the fuchsinophile pale red to red-yellow colloid is predominant in the toxic goiter and the blue and violet colloid is solely predominant in the normal thyroid gland and in atoxic goiter.

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<sup>1</sup> According to information from Doctor N. GELLERSTEDT at Upsala, the method has been used there for thousands of struma cases. In order to be able to use this method for purposes of diagnosis, however, it is necessary to be well acquainted with its limitations, and this is possible only after much experience. The staining effect depends on physical changes in the substance of the colloid (see page 4). Therefore all kinds of staining artefacts may result which, for the inexperienced are difficult to ascertain and which, surely, have contributed to the fact that the method has often been discredited. As long as one has not used a suitable fixative (formaline) the right embedding (paraffin) and thickness of the section as well as to examine sufficiently large blocks taken at a right angular cut through the free surface of the operative preparation, it is impossible to eliminate the disturbing influence of staining artefacts and the method fails. But rightly used and with access to a large comparative material, the method is valuable in classifying the different groups of goiter.



Kraus's method of staining has been sharply criticized by WAIL (1922) and ABRIKOSSOFF (1924) who state that the varying staining of the colloid depends on certain physical and mechanical influences when preparing the specimen. They therefore doubt the value of the method. KRAUS (1923), on his part, successfully and vigorously, defended his method. Further, the method has been recommended by KAFKA (1921) and MORGEN (1924) and others. It is therefore all the more interesting to make a comparative investigation with the present material in which Kraus's staining method has been used simultaneously with other usual methods (Htx. van Gieson or eosin).

The author has not personally made any histological examinations. Consequently, the histological diagnosis is based solely on the opinions obtained from the Pathological Institute at Upsala. It might be of value here to give a more detailed definition of the pathological terms used as, to some extent, they differ from those used by other authors.

*Struma Basedowi* refers to the diffuse goiter with pronounced histological signs of toxicité.

*Struma Basedowoides diffusa* signifies that there are diagnosable cellular, structural Basedow signs remaining in varying degrees.

*Struma dysincratoria diffusa* takes no cellular, structural Basedow signs but clearly shows pathological colloid on Kraus staining.

*Struma nodosa colloides dysincratoria* is a goiter rich in colloid, nodulous, toxic with a thorough or preponderant red-stained colloid according to KRAUS. It is mainly the colloid between the nodes which shows pathological staining.

*Struma nodosa colloides Basedowoides* indicates the above form with, in addition, a certain degree of Basedow changes in the follicles and epithelium.

Thus the essential part of this terminology is that the indication "basedowoides" refers to the cellular, structural changes and the indication "dysincratoria" refers to the presence of red-stained colloid in Kraus's preparation. From the above, the morphological difference between the diffuse Basedow struma and the toxic nodulous colloid struma appears clearly.

Comparative examinations carried out from clinical and histological pictures in goiter cases have been directed mainly towards the effect of iodine treatment on toxic struma (TROELL, MUNCH, HOLST, CATTEL, RIENHOFF, MERKE and others). All of these

authors confirm a retrogression of the signs of toxicity in the histological preparation following iodine treatment. In some cases the toxic picture has completely disappeared. The examinations have partly been carried out by comparison between cases treated with iodine and those not treated with iodine (TROELL, HOLST), partly by hemistrumectomy in different stages of the iodine treatment (CATTEL) and partly by protatory excisions in connection with the ligation of art. thyr. sup. at the beginning of the iodine treatment and comparison with the preparations taken during the different stages of the iodine treatment.

According to TROELL, only a week's treatment with Lugols solution was necessary in slight cases whilst, in more severe cases, up to six weeks treatment was needed to obtain an atoxic picture. In the material collected by him, something more than half of the cases presented an atoxic picture after iodine treatment. A fifth of them still showed a typical Basedow picture. Other authors maintain that, even after iodine treatment one finds some signs of toxicity in the form of slightly raised epithelium, colonies of lymphocytes or remaining scattered islands of toxic appearance. One may well suppose that the diverging results depend partly on the different valuations of the histological pictures or because different histotechnical methods have been used.

### Personal Investigations.

159 cases treated at Ludvika Hospital during the years 1938—1945 are investigated, all of which were histologically examined at the Pathological Institute in Upsala. The clinical diagnosis was made after a careful study of the case reports and quite independent of the pathologists' opinion. I have personally been able to observe a large number of the patients whilst they were in hospital. 70 of them have been classified as being clinically toxic and 89 as atoxic. All of the cases stated as toxic were treated with iodine except two who received quinine phosphate. As a rule the iodine treatment lasted from ten days to two weeks and the operation has not been performed until the patient showed considerable improvement in his general condition and an increase in weight. Unfortunately a continual control of the metabolism was not carried out except in the more serious cases. A number of the cases classified as atoxic also received iodine but as these

were operated on after a few days in hospital they seldom received iodine for more than five days.

As previously mentioned, the clinical diagnosis of some of the cases is somewhat uncertain. Cases showing a reasonable increase in metabolism but without showing other clinical signs of toxicity have been classified as atoxic whilst those having an insignificant increase in metabolism have, because of other clearly expressed clinical symptoms, been classified as toxic. The reason why the metabolism test has been undervalued in certain cases can be explained by the fact that often only one or two such tests have been taken and then only on the first or second day in hospital and without any special preparation.

The attached four tables show the results. An explanation of the signs used in the tables is as follows:

Under the heading "iodine", + signifies more than 8 days iodine treatment, whilst (+) signifies less than 8 days treatment.

H signifies generally high epithelium.

(H) signifies high epithelium in certain regions.

h signifies insignificant increase in epithelium within certain regions.

L signifies generally low epithelium.

R signifies colloid red in Kraus's preparation.

(R) signifies colloid red in certain regions.

B signifies colloid blue and violet in Kraus's preparation.

? signifies information missing in case in question.

Eye symptoms: ++ signifies clear Graefe, eventually exophthalmus.

+ signifies less pronounced eye symptom.

## Discussion.

Tables 1 and 2, clinically toxic.

Of 70 clinically toxic cases, all of which, except 2, received the usual preoperative iodine treatment, 16 have been classified atoxic by the pathologist (table 2). A closer scrutiny of the table shows that even among these one finds slight epithelial changes which have nevertheless been considered far too insignificant to classify the preparation as having originated from a toxic struma. Therefore the iodine treatment appears to have had considerably less influence on the histological picture in these material than in that of other authors. A general opinion is expressed by



Table 1 (cont.).

P. A. D.	Kraus's staining	Epithelium	Weight of re-moved gland	Loss of weight	Tachycardia	Tremor	Eye symptom	BMB + %	Iodine	Case history
Struma diffusa basedowoides	(R)	H	85	+	0	+	0	41	+	1473/41
Toxic adenoma	R	(H)	85	+	0	+	+	62	+	1508/41
Struma basedowi	(R)	H	42	?	+	+	0	30	+	355/42
» »			40	+	+	+	+	53	+	455/42
» »			200	?	+	+	+	72	+	593/42
» »			?	+	+	+	+	45	+	630/42
Toxic adenoma	(R)	L	58	?	+	+	+	40	+	659/42
Struma basedowi	R	H	40	0	+	+	0	68	+	889/39
» diffusa basedowoides	(R)	H	52	0	+	+	0	41	+	1365/42
Toxic adenoma	R	(H)	85	+	?	+	+	35	+	1440/42
Struma diffusa basedowoides	R	H	86	0	0	+	+	58	+	1744/42
» basedowi	R	H	112	0	+	+	+	61	++	445/43
» »	R	H	?	+	+	+	+	33	+	1063/43
» »	R	H	?	+	+	+	+	120, 15	+	1106/43

Table 2.

*Cases clinically toxic, histologically atoxic.*

P. A. D.	Kraus's staining	Epithelium	Weight of re-moved gland	Loss of weight	Tachycardia	Tremor	Eye symptom	BMB + %	Iodine	Case history
Possible signs of toxicity	?	h		0	+	+	+	41, 15	+	1191/38
» » » »	?	h		+	+	+	+	26	+	1217/38
Atoxic	B	L		0	+	+	+	15, 24	+	1372/38
»								17, 34		
Possible signs of toxicity	B	L		0	+	+	+	19	+	1411/38
» » » »	B	h		+	+	+	+	39	+	1562/38
» » » »	B	h		+	0	+	0	42	+	1572/38
» » » »	(R)	L		+	+	+	0	46	+	1616/38
Atoxic	B	h	180	0	+	+	+	92, 55	+	6/39
								32, 45		
»	B	h	177	+	+	+	+	9	Kf	1085/39
»	B	L	222	0	+	+	+	28	+	1868/39
»	B	L	45	+	+	+	+	25	+	1819/40
»	B	L	50	+	+	+	0	48	+	2084/40
»	B	L	210	+	0	+	+	68, 37	+	1320/41
»	B	h	130	+	+	+	0	62	+	1644/41
»	B	h	160	0	+	+	0	30	+	313/42
»	?	L	73	0	+	+	+	19	+	549/42

CAMERON in "Recent advances in endocrinology (1945)" in the following sentence: "The change is so marked and the use of iodine in pretreatment is now so universal, that the appearances which used to be regarded as typifying Graves' disease are now seldom seen." It is difficult to say anything regarding the results obtained in the Ludvika material. Naturally the intensity of the iodine treatment plays a great part. As, however, the iodine treatment took place in accordance with customary principles, the difference in this respect ought to be small as compared with other authors. The histological diagnosis has been made by trained pathologists and by noting the changes observed in the preparation. In three of the cases noted as toxic, the diagnosis toxic has been made solely on account of red-stained colloid in Kraus's preparation with a simultaneous occurrence of low epithelium. On the other hand the pathologist, in certain cases in table 2, has not taken into consideration the insignificant increase of epithelium when the colloid was stained blue in the Kraus's preparation. Therefore Kraus's staining has, to a certain extent, exercised influence on the patho-anatomical diagnosis.

Tables 3 and 4, clinically atoxic.

Among 89 clinically atoxic cases one finds 17 with a toxic histological picture (table 4). Without doubt, the explanation is that a slight toxicity has been clinically overlooked or that it has not yet manifested itself in the clinical picture. If the figures for metabolism are examined, some relatively high values will be found in tables 3 and 4. The fact that some of the cases classified as atoxic have received a transient iodine treatment explains, to some extent, the fact that the diagnosis has been somewhat uncertain. As a rule, the iodine treatment given in atoxic cases can be considered as being immaterial, as the operation, but for a few cases, has taken place on the second or third day in hospital. In table 4, however, one finds five cases classified as atoxic, who have received iodine treatment for more than eight days. These cases, however, show an insignificant increase of metabolism and should, perhaps, have been classified as toxic. And despite the iodine treatment, the pathologist has also found signs of toxicity which tends further to show that the iodine treatment has not had the general influence on the histological picture which one previously expressed.

With regard to staining in accordance with Kraus's method the tables tell us that there is a very good agreement in so much as

Table 3.

*Cases both clinically and histologically atoxic.*

Case history	Iodine	BMB + %	Other clinical signs	Weight	Epithelium	Kraus's staining	P. A. D.
1262/38	+	3, 10	Neurasthenia		L	B	Atoxic
1558/38	+	8			L	B	"
65/39	0	?			L	(R)	"
175/39	0	27		280	L	B	"
210/39	(+)	11		50	L	B	"
410/39	(+)	14		170	L	B	"
885/39	0	4		?	L	B	"
939/39	0	5, 4		56	L	B	"
1021/39	(+)	-14		?	L	B	"
1655/39	0	9		153	L	B	"
1663/39	0	11		115	L	B	"
1936/39	+	31, 18, 5		60	L	B	"
218/40	0	3		78	L	B	"
870/40	+	24		?	L	B	"
933/40	0	11		?	L	B	"
1083/40	+	37		?	L	B	"
1152/40	(+)	40		?	L	B	"
1623/40	0	21		?	L	B	"
1969/40	0	?		180	L	B	"
2000/40	0	8		38	L	B	"
2129/40	0	21		50	L	B	"
2136/40	+	16, 14		?	L	B	"
99/41	0	7		120	L	B	"
807/41	(+)	11		104	L	B	"
1135/41	0	13		?	L	B	"
1142/41	+	3		40	h	B	"
1421/41	0	25, 12		?	L	B	"
1437/41	+	?		82	L	B	"
1510/41	0	17, 26		?	L	B	"
551/42	0	5, 37, 16, 10, 3		?	L	?	"
314/42	0	-1		63	h	B	"
395/42	(+)	5		?	L	B	"
495/42	0	-8		135	L	B	"
542/42	0	4		105	L	B	"
673/42	0	3		?	L	B	"
991/42	0	3		30	L	B	"
1025/42	(+)	34		640	L	B	"
1043/42	0	5		big	L	B	"
1116/42	0	-3, -7		?	L	B	"
1135/42	0	8, 2		25	L	?	"
1206/42	0	-2		105	L	B	"
1033/42	0	-1					(cyst.)
1210/42	0	-7					"
1268/42	(+)	10		42	?	?	"
1468/42	0	4		275	L	B	"
1512/42	0	3		500	L	B	"
1562/42	0	11		155	L	B	"
151/43	0	?		40	L	B	"
173/43	(+)	20		55	L	B	"
192/43	(+)	10		310	L	B	"
				150	L	B	"

Table 3 (cont.).

Case history	Iodine	BMB + %	Other clinical signs	Weight	Epithelium	Kraus's staining	P. A. D.
352/43	0	4		75			Atoxic (adenoma)
361/43	(+)	42		211	L	B	»
398/43	0	8		116	L	B	»
493/43	0	25		340	L	B	»
494/43	(+)	17		55	L	B	»
532/43	0	13		45	L	B	»
548/43	(+)	11		?	L	B	»
572/43	0	17		106	L	B	»
581/43	(+)	24		850	L	B	»
628/43	(+)	30		220	L	B	»
669/43	(+)	?		?	L	B	»
683/43	(+)	20		130	L	B	»
735/43	0	16		120	L	B	»
854/43	0	8		110	L	B	»
855/43	(+)	33		335	h	B	»
862/43	0	5		168	L	B	»
903/43	0	28		35	L	B	»
932/43	(+)	14, 35		105	L	B	»
961/43	(+)	35		80	L	B	»
1074/43	0	13		?	L	B	»
1086/43	0	23		?	L	B	»
1363/43	0	29		?	L	B	»

the red-stained colloid together with the high or partly high epithelium appears simultaneously. Among all the cases there are only nine with low epithelium and red colloid. In all of these, with one exception (no. 65/39), the pathologist has stated that the red-stained colloid indicates a certain degree of toxicity. High epithelium together with blue colloid also occurs in nine cases, but the epithelium is only slightly changed in eight of them. Four of these have been classified atoxic by the pathologist (table 2), whilst in the other five cases hypertrophied epithelium has been regarded as a sign of toxicity despite the blue-stained colloid.

Apart from these few cases, one finds a very good agreement between the colloid staining and other pathological changes indicating toxicity. In the first place it appears from the tables that a large measure of agreement exists between the red-stained colloid in Kraus's preparation and the clinically diagnosed toxicity. Therefore Kraus's staining method can be recommended as a reliable method in microscopic examination of struma preparations.



Table 4.

*Cases clinically atoxic, histologically toxic.*

Case history	Iodine	BMB	Other clinical signs	Weight	Epithelium	Kraus's staining	P. A. D.
1694/38	+	10, 13	myocarditis	?	L	(R)	Str. nod. colloides dysincratoria
145/39	0	—4		85	(H)	R	Str. nod. colloides dysincratoria
732/40	0	—6		168	L	(R)	Str. diffusa base-dowoides
33/41	+	4		?	H	B	Str. nod. colloides basedowoides
672/41	(+)	28, —2, —4		120	?	R	Toxic adenoma
1542/41	0	42		83	(H)	R	Toxic adenoma
1241/42	0	19		140	H	R	Str. diffusa base-dowoides
1299/42	0	?		20	H	R	Toxic adenoma
1467/42	+	30	tbc. pulm.	42	(H)	(R)	Str. nod. colloides dysincratoria
1605/42	0	11, 0		320	(H)	(R)	Str. diffusa base-dowoides
1632/42	0	6		32	(H)	R	Str. nodosa colloides dysincratoria
193/43	+	37		220	(H)	(R)	Str. nod. colloides dysincratoria
609/43	0	2		155	H	R	Str. diffusa base-dowoides
644/43	0	13		800	(H)	(R)	Str. nod. colloides dysincratoria
810/43	+	36		?	(H)	(R)	Str. diffusa base-dowoides
1073/43	0	13, 18		?	(H)	(R)	Str. diffusa base-dowoides
1087/43	(+)	?		?	(H)	(R)	Toxic adenoma

**Summary.**

The present study discusses the relation between the clinical and histological picture in surgically treated goiter cases.

A method of staining the colloid published 1914 by KRAUS is tested with regard to its accuracy. Kraus's statement that the toxic cases show red staining is collaborated by the author and the method is recommended.

The preoperative iodine treatment has not, in this material, influenced the histological picture in such a degree as described by previous authors. This treatment has diminished but not abolished the toxic symptoms.

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From the Surgical Clinic, Karolinska Sjukhuset, Stockholm.  
(Chief: Professor JOHN HELLSTRÖM.)

## The Value of Preoperative Heart Examination.

A study based on material at the Surgical Clinic of  
the Karolinska Sjukhuset, Stockholm,  
1940—1944.

By

WOLFRAM KOCK.

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When a surgeon is faced with the problem of determining whether a case is one of operation or expectance it is sometimes a purely interno-medical factor which decides the question, namely, the status of the patient's heart. It is therefore of great importance that the surgeon gets a clear idea of what the patient can stand by carefully studying the anamnesis and performing clinical and cardio-functional tests, as well as obviously taking into consideration the amount of strain which the planned intervention together with the administered anaesthetic and after-course might reasonably be assumed to involve. This would seem reasonably obvious, but to judge from the reports available in literature, it is no easy matter to make a decision in this delicate question. No modern surgeon should be content today with judging the condition of the heart on a purely physical investigation in cases where doubt as to whether or not cardiac disturbance prevails. Ecg and roentgen, either one or both, should be controlled to some great extent in such cases, and of a certainty much valuable information concerning the state of the heart can be gained from the same.

### History.

The question respecting the preoperative investigation of the heart and arteries has earlier been the object of great interest. In 1937 it was also debated at a meeting of the Scandinavian Surgical Society, at Gothenburg. Limited space permits only of a very brief and schematic

survey of the most important works in this domain, which have been published of later years. Reference is made to the various original works mentioned in the bibliography.

That the question is of great practical importance is obvious from the fact that the postoperative deaths characterized as cardiac death in the majority of the published statistics are appallingly frequent: ROST (1927) counts with 10 % of the total operative deaths, v. EISELSBERG (more than 1,700 gastric operations), 9.09 %, MAIDITSCH and ORATOR (3,500 abdominal and pelvic operations), 13 % (= all the deaths in the series), BUTLER, FEENY and LEVINE, 1930, (466 cases with organic heart disease), 12 %, FOGED and GEILL, 634 postoperative deaths of which 15 % due to heart disease. In WESTERBORN's statistics from the Uppsala clinic, 1920—29, the total operation mortality was 5.76 %. This figure included deaths to 5 % from cardiac insufficiency, whereas death from postoperative shock was excluded. PETRÉN unfortunately publishes no special group for heart complications in his report on post operative death causes at the Lund clinic during the period 1929—1938. He includes these in the so-called Group 2 (very poor general condition, high age or generally impaired strength, pronounced cardioarteriosclerosis, heart insufficiency, severe asthma complicating lung tbc or carcinoma, and interventions of too serious a nature with regard to the patient's state): 82 cases out of 1,260 deaths after 24,816 operations. In "Diseases of the Heart", 1934, LEWIS estimates the increase of mortality in larger and smaller operations on cardiac patients to 5 % and only includes verified heart diseases and lethally progressive postoperative complications. In reference to operation trauma and anaesthesia MARVIN (1928) stated that there is no convincing evidence that either anaesthesia or the operation itself has any harmful effect on the normal heart, assuming that the anaesthesia is rightly administered.

BJERLÖV (1935) considers preoperative eeg and heart roentgen of great importance and maintains that eeg is especially so in the event of cardiosclerosis. He is of the opinion that conduction disturbances are of much significance and puts forth cardiac infarction, even one that is healed, as the only contra-indication against operation as regards cor.

REHN (1936) has analysed the tolerance of the heart and circulation in the event of direct and indirect surgical strain and is of the assumption that the essential danger to the cardiac and vascular systems, with reference to operations and anaesthesia, lies in the "lability of the circulatory system".

A basic investigation has been made with reference to this debated question by FOGED and GEILL (1937). The material included 428 cases from Bispebjerg's Hospital from the period 1928—1935. All were eeg examined and 398 underwent preoperative roentgen. There were two groups consisting of 372 operation cases and 56 non-operation cases. Of 351 operation cases with no clinical pathologic cardiac changes 253 revealed normal eeg and rtg conditions. The postoperative mortality from weakness of the heart in these cases was 1.1 %, while in the other group (about 100 cases) the percentage was 11.8.

Another Danish investigation was made by JOHANSEN (1937). The material (from the surgical Department of the Sundby Hospital), showed that the mortality among patients with left preponderance was twice as great and among patients with degenerative myocardii three times as great as among patients with normal eeg, while the mortality was not quite twice as great with pathologic rtg as normally.

TROELL (1937) made reference to a material which embraced 300 cases of operated thyreotoxicosis and about 100 operation cases of another kind. All were examined with eeg or rtg, or both. He found that a thyreotoxicosis with pathologic cor rtg and eeg finds has an operative mortality risk almost three or four times greater than one with normal conditions. In the other group (which must be considered fairly small to allow of any statistic conclusions), the operative mortality risk would be more than twice as great in the event of pathologic eeg than with the normal.

BRODERSEN, 1938 (Surg. dept. of the University, Oslo), is of the opinion that one cannot a priori attach too much importance to eeg as an indicative factor in operations.

RÖMCKE (1938—1939) (The Drammen Hospital), after an investigation which included 400 cases, came to the conclusion that preoperative routine eeg is unnecessary; but that every case with any heart abnormality, and particularly arrhythmia, should be eeg examined.

JERWELL & HARBITZ (1938) made similar observations with regard to a material of stromectomy and thoraeoplasty cases.

SANDBERG (1938) (Surg. Clin. of the Maria Hospital, Stockholm 1932—1936), points out that myocardial injuries are the most serious when, with reference to the heart, the indications for or against operation have to be determined.

It has been stressed from various quarters that the heart patients who run the greatest operation risks are those who suffer from disturbances in the coronary arteries. By reason of the same, a survey published by BRUNN and WILLIUS (1939, Cardiolog. Dept. of the Mayo Clinic) comprising 257 cases of serious coronary trouble which were subjected to greater surgical interventions, should be of much interest. The duration of the operation and anaesthesia as well as cautious operative technique, they consider as essential points. The indications should be kept very close.

BRECHLING and HANSEN (1939) studied the eeg conditions prior to, during and after the administration of anaesthesia in connection with moderate surgical interventions (ether, local or lumbar anaesthesia). With ether narcosis changes were revealed in the "normal cases" in 76 % (cf. FOGED and GEILL, 1938, 80 %) and in the total material 64 %, while the preoperative pathologic eeg cases manifested enhancement of the changes.

KORTH (1940) called attention to the importance of accurate anamneses — as well as eeg anamneses for heart prognosis.

OPSAHL (1940) who drew special attention to the significance of anemia and peripheral circulatory disturbances is of the assumption that all individuals over 45 years should undergo eeg examination pre-

operatively and, moreover, in every case where risk for impaired coronary circulation, considerable drying and hemorrhage is anticipated.

BRODERSEN, HARBITZ & JERWELL as well as RÖMCKE (1943) are of the opinion that cardiac insufficiency symptoms are of far greater value in determining the state of the heart preoperatively than ecg alone.

NORDENFELT (1944) avers that the greatest risk for a patient with a weak heart, during the operation itself, is the provocation of reflexes, which can bring about arrhythmia and impairment of the coronary circulation. As absolute contra-indications are mentioned, fresh cardiac infarction, uncompensated auricular fibrillation with speedy ventricular taet and paroxysmal tachycardia during an attack. Incompensation and arteriosclerosis of the coronary arteries he regards as relative contra-indications. NORDENFELT recommends ecg examination of every patient above 45—50 years of age, prior to greater operative interventions.

### The Author's own Material.

The present author has sought to find an answer to the question concerning the value of the prevalent preoperative cardiac investigation through analysing a material of 406 operation cases from the surgical clinic of the Karolinska Sjukhuset during the years 1940—1944 which were preoperatively examined both with ecg and heart roentgen. The cases have not been selected. They were taken successively and distributed in six groups with up to 100 cases in each group.

Group			Numb. of cases.
I	= VII	(thyreoidea) the latter figure refers to the	
"	II = VIII	group scheme in the clinic's records . . . . .	100
	IX	(thorax, plenra, lungs)	
"	III = XI	(mother) . . . . .	44
	XII	(gall-ducts)	
	XIII	(pancreas)	
"	IV = XIV	(spleen) . . . . .	58
"	V = XV	(stomach and duodenum) . . . . .	49
	XXVIII	(the small intestine and colon)	
"	VI = XX	(rectum and anus) . . . . .	59
	XXI	(kidneys and ureters)	
	XXII	(bladder)	
	XXIII	(the prostate)	
	XXIII	(urethra and penis)	
	XXIV	(epididymis and testis) . . . . .	100

The cases have been limited to 100 in order to avoid an all too great statistic error in the comparison with groups within which, unfortunately, such a large number of cases of patients examined

in the above manner are not at our disposal. In spite of the same, the number of cases, with this classification, has become rather small, and especially with reference to Groups II and IV, but it must also be considered inexpedient to form larger groups of all too heterogeneous categories. In the analysis of the material those cases which displayed postoperative complications, and which in this connection are of the greatest interest, have been kept apart.

Cases which ran their course without postoperative heart complications have been classified under the indication "Sec. I", and those which were attended by postoperative heart complications are indicated as "Sec. II".

### Age and Sex.

The postoperative cases without heart complications (Sec. I) display the greatest number of younger ages within Group I (thyreoidea) and the greatest number within older age classes in Group VI (urologic cases).

Sec. II, with reference to age, reveals, as expected, an accumulation within the higher ages (50—70 and upwards), but solitary cases have also been found within the age classes 21—50 years.

#### *Age distribution.*

Age in years	Cases with no postop. heart complic.						Cases with postop. heart complic.					
	G r o u p						G r o u p					
	I	II	III	IV	V	VI	I	II	III	IV	V	VI
0—10 .....	—	—	—	—	—	—	—	—	—	—	—	—
11—20 .....	5	—	—	1	—	—	—	—	—	—	—	—
21—30 .....	25	—	1	—	—	—	—	1	—	—	—	—
31—40 .....	22	2	5	2	—	3	—	—	1	—	—	1
41—50 .....	22	5	12	8	4	7	—	—	—	—	—	—
51—60 .....	19	12	19	16	12	15	1	1	1	2	1	—
61—70 .....	5	9	15	14	22	38	1	1	1	—	2	—
71—80 .....	—	9	1	6	15	32	—	1	—	—	1	1
81—90 .....	—	1	—	—	—	2	—	—	—	—	—	1

As regards the sex distribution women are obviously predominant to a considerable extent in Groups I, II and III, while men are in the majority within Group VI. The total number of cases with postoperative heart complications is for men 10 and



for women 8, with preponderance for women in Groups I and II, and for men in Groups V and VI.

*Sex distribution.*

	Cases with no postop. heart complic.						Cases with postop. heart complic.					
	G r o u p						G r o u p					
	I	II	III	IV	V	VI	I	II	III	IV	V	VI
Men .....	11	2	7	30	34	87	—	—	2	2	3	3
Women .....	87	36	46	17	19	10	2	4	1	—	1	—

**Anamnesis.**

With reference to cardiac diseases the value of utmost exact anamneses has been emphasized from various quarters. This is obviously of the greatest importance when it is a question of taking a preoperative attitude to the functional capacity of the heart. On studying the medical reports on this material one gets the impression that the writer in question has taken this into consideration to some great extent. In the majority of cases more or less exact information on earlier cardiac troubles has also been given. The material has therefore been submitted to a closer analysis even in respect to the anamnestic finds although here the question is one of routine reports with no special regard to the heart. The Table below gives a reproduction of the anamnestic reports on the 406 cases dealt with here.

*The following is a closer study of the various groups.*

**Sec. I.**

*Group I.* Nothing pathologic has been observed in the anamneses of 21 cases (in this number, as regarding other groups, cases have obviously been included where nothing relative to pathologic heart conditions has been reported). The most common finds have otherwise been: valvular disease, myocarditis, and combinations of these. Only cases here and there in the other anamnestic groups.

*Group II.* Nothing pathologic: 9 cases. The most usual symptoms have been valvular disease, hypertonia and valvular disease + myocarditis.

*Group III.* In this group there are not less than 31 cases indicated

*Anamnestic finds.*

	Cases with no postop. heart complic.						Cases with postop. heart complic.					
	G r o u p						G r o u p					
	I	II	III	IV	V	VI	I	II	III	IV	V	VI
Anamn. 0 path. . . .	21	9	31	32	32	51	—	1	1	1	4	1
Polyarthrit. . . . .	3	4	9	2	3	10	—	—	—	—	—	—
Valvular disease . .	7	9	10	7	5	17	—	—	—	—	2	—
Cardiosclerosis . . .	2	2	—	1	2	4	—	—	—	—	—	1
Myocarditis . . . . .	4	1	2	1	3	6	2	—	1	—	—	—
Hypertonia . . . . .	—	4	2	1	2	6	—	1	—	—	—	—
Valvular disease + myocarditis . . . . .	3	3	2	1	4	4	—	1	1	—	—	—
Valvular disease + cardiosclerosis . . .	—	—	—	—	—	2	—	—	—	—	—	—
Valvular disease + hypertonia . . . . .	1	1	2	1	—	2	—	—	—	—	—	—
Valvular disease + myocarditis + cardiosclerosis . . .	—	—	1	—	—	—	—	—	—	—	—	—
Valvular disease + myocarditis + hypertonia . . . . .	—	1	—	—	1	—	—	—	—	—	—	—
Cardiosclerosis + myocarditis . . . . .	2	1	—	1	—	1	—	—	—	—	—	—
Cardiosclerosis + hypertonia . . . . .	—	1	—	—	—	1	—	—	—	—	—	—
Myocarditis + hy- pertonia . . . . .	—	1	—	—	3	1	—	—	—	—	—	—
Pericarditis . . . . .	—	—	—	—	—	—	—	1	—	—	—	—

non-pathologic but valvular disease was found in the majority of the other cases.

*Group IV.* Likewise a high figure with no pathologic finds: 32 cases, otherwise valvular disease dominates, but other symptoms occur in rare cases.

*Group V.* Reveals the same figure as the foregoing with regard to nothing pathologic, otherwise valvular disease, valvular disease + myocarditis, myocarditis and myocarditis + hypertonia are the commonest among the pathologic finds.

*Group VI.* Nothing pathologic is revealed in more than half of the cases (51). Valvular disease dominates the pathologic finds considerably. Myocarditis, hypertonia, cardiosclerosis and valvular disease + myocarditis most frequently occur.

See. II.

In the cases which ran their course with postoperative complications valvular disease and myocarditis were of the most frequent

occurrence. It is of interest to note, however, that no pathologic finds had occurred in the anamneses of not less than 8 of the 20 cases.

The occurrence of polyarthrititis in the anamnesis has been paid special attention and is also reported in a special column in the Table. In Sec. I there are only 31 cases and, what may perhaps be emphasized, 0 cases in Sec. II.

### Physical and Laboratory Finds.

In this investigation attention has been paid to physical finds which have been obtained through inspection, auscultation, percussion and palpation, pulse conditions (normal limit at 80), blood pressure (normal limit 150), Heller and non-protein nitrogen (normal limit 40 mg%). When there were no pathologic finds in any of these respects the indication was "nothing pathologic". In some cases information has been lacking in the reports and an account of the same is given in the following Table.

*Group I. Sec. I:* Nothing pathologic: 29 cases. Inspection: Single cases with dyspnoea and edema. Palpation, percussion and auscultation: Especially heavy apex beat, enlargement of heart, tachycardia (18), accent and systolic murmur. Heller was neg. in 80 cases. N.P.N. was not taken in 88 cases. Blood pressure exceeded 150 in 33 cases and the pulse was above 80 in 50 cases. *Sec. II* coincides on the whole with Sec. I, but no case is quite normal. The others are of no interest.

*Group II. Sec. I:* Pathologic in 4 cases only. Inspection: cyanosis (4), edema (2). Palpation, percussion and auscultation: accent (14), systolic murmur (11). Most worthy of note are hollow tones, rhythm disturbances, enlargement, tachycardia and extra systolia. Heller was neg. in 32 cases. No N.P.N. in 35 cases. *Sec. II:* No case quite normal. 2 cases displayed dyspnoea and 2 edema.

*Group III. Sec. I:* Nothing pathologic in 10 cases. The majority of cases revealed systolic murmur (23), hollow tones, accent, dyspnoea and extra systolia in the present given order. Heller was neg. in 47 cases. No N.P.N. in 37 cases. Blood pressure exceeded 150 mm Hg in 20 cases. Hg in 31 cases and the pulse exceeded 80 in 18 cases. *Sec. II:* nothing pathologic in 1 case, otherwise stray instances.

*Group IV. Sec. I:* Nothing path. in 25 cases. Systol. mur. in 11 cases. Coming next, the most frequent were recurring hollow tones

*Physical and laboratory finds.*

	Cases with no postop. heart complic.						Cases with postop. heart complic.					
	Group						Group					
	I	II	III	IV	V	VI	I	II	III	IV	V	VI
Nothing path. . . . .	29	4	10	25	5	7	—	—	1	—	—	—
Cyanos. . . . .	—	4	1	2	5	9	—	1	1	—	—	—
Accent . . . . .	15	14	8	3	6	22	—	1	—	—	1	—
Bld. press: < 100 . . . . .	—	—	—	2	—	—	—	—	—	—	—	—
100—150 . . . . .	57	8	4	28	26	27	—	1	2	1	3	2
150—200 . . . . .	30	22	17	8	14	43	—	1	1	—	1	1
> 200 . . . . .	3	5	3	3	8	18	—	1	—	1	—	—
Diastol. mur. . . . .	—	2	1	—	—	—	—	—	—	—	—	—
Hollow tones . . . . .	2	4	9	8	9	—	—	—	—	2	1	1
Dyspnoea . . . . .	1	3	3	—	4	8	—	2	—	—	—	—
Extra systol. . . . .	3	3	3	2	4	—	—	—	1	—	—	—
Enlargement of ht. . . . .	8	3	4	1	3	6	—	—	—	—	—	1
Heller pos. . . . .	4	2	—	—	4	50	—	1	—	—	1	2
" neg. . . . .	80	32	47	42	40	40	1	1	2	2	2	1
Hepar palp. . . . .	—	—	1	—	—	—	—	1	—	—	—	—
Cough . . . . .	—	—	—	—	—	1	—	—	—	—	—	—
Heavy ap. beat . . . . .	6	1	1	1	—	3	—	—	—	—	—	—
Jug. pulse . . . . .	—	—	—	—	—	1	—	—	—	—	—	—
Pulse: < 80 . . . . .	43	25	36	31	39	70	—	—	2	2	2	3
> 80 . . . . .	50	12	18	16	14	26	1	4	—	—	2	—
Pulsations above precord . . . . .	—	—	—	1	—	1	—	—	—	—	—	—
N.P.N. < 40 . . . . .	9	2	15	22	33	71	—	1	—	1	2	2
> 40 . . . . .	1	—	1	2	4	19	—	—	—	—	1	—
Rhythm. disturb. . . . .	7	3	—	1	3	9	—	1	—	—	—	—
Stasis wheeze . . . . .	—	—	1	—	—	—	—	1	—	—	—	—
Syst. mur. . . . .	4	11	23	11	17	28	2	1	1	—	3	—
Syst. and diast. murmur . . . . .	2	—	2	—	1	3	—	—	—	—	—	—
Tachycardia . . . . .	18	3	—	—	—	1	1	—	—	—	—	—
Wave beat . . . . .	—	—	—	—	—	—	—	1	—	—	—	—
Edema . . . . .	2	2	1	—	1	2	—	2	1	—	—	—
<i>No report on</i>												
Bld. press. . . . .	10	2	2	6	5	7	1	—	—	—	—	—
Heller . . . . .	11	2	5	4	8	5	—	1	2	—	1	—
Pulse . . . . .	2	—	—	—	—	1	—	—	1	—	—	—
N.P.N. . . . .	88	35	37	22	15	6	2	3	3	1	1	1

and accent. Heller was neg. in 42 cases. No N.P.N. in 22 cases. Blood press. exceeded 150 mm Hg in 11 cases and the pulse 80 in 16 cases. *Sec. II:* No case quite normal. Otherwise nothing remarkable.

*Group V. Sec. I:* Nothing path. in 5 cases. Sys. mur. in 17 cases, otherwise the most frequent occurrences are hollow tones, rhythm disturbance, cyanosis and dyspnoea as well as extra systolia. Heller

was neg. in 40 cases. No N.P.N. in 15 cases. Blood press. exceeded 150 mm Hg. in 22 cases with pulse exceeding 80 in 14 cases. *Sec. II*: No case normal. Most frequent, syst. mur. (3).

*Group VI. Sec. I*: Nothing path. in 7 cases. Not less than 28 cases revealed syst. mur. and 22 accent, 9 rhythm disturbance, cyanosis resp. and 8 dyspnoea. Heller was neg. in only 40 cases and pos. in not less than 50. In 61 cases the blood press. exceeded 150 and the pulse was above 80 in 26 cases. *Sec. II*: No case quite normal. Nothing remarkable otherwise.

### Electrocardiographic Examination.

Attention has been called from many directions, as already mentioned, to the value of the electrocardiographic investigation for quickly apprehending the functional condition of the heart, even when it concerns the possibility of having to endure a surgical intervention. The electrocardiographic analysis of this present material reveals a multitude of disturbances.

Normal eeg, in cases without postoperative heart complications have occurred in 45, 14, 33, 25, 16 and 18 cases resp. within the various groups. Left preponderance should be a disturbance of very little importance and has consequently been excluded here. It has occurred very frequently in 13, 6, 5, 6, 15 and 19 cases in *Sec. I*. The most common eeg disturbance in this material has proved to be coronary insufficiency (68 cases in *Sec. I* and 5 in *Sec. II*). The next in turn is rhythm disturbance (43 cases in *Sec. I*, 2 in *Sec. II*), likewise combinations of the same (18 cases in *Sec. I* and 0 in *Sec. II*). The eeg disturbances are distributed within the various groups in the following manner: *Sec. I* Groups I: 39, II: 18, III: 17, IV: 16, V: 21 and VI: 59, thus, the highest figure in Groups I and VI. It is of interest to note that 5 cases in *Sec. II* have revealed no pathologic changes. The postoperative complications from cor in the said cases, have included insufficiency cordis (3 cases) and fibrillation (2 cases). Eeg disturbances in *Sec. II* have comprised coronary insufficiency (5 cases), rhythm disturbance and conduction disturbance + coronary insufficiency (each 2 cases). The eeg disturbances in *Sec. II* are distributed in the following manner: I: 1, II: 3, III: 3, IV: 0, V: 4, VI: 3.

The electrocardiographic strain tests (eeg during work and hypoxemia test introduced of late years), likewise combined take

*Ecg changes.*

	Cases with no postop. heart complic.						Cases with postop. heart complic.					
	G r o u p						G r o u p					
	I	II	III	IV	V	VI	I	II	III	IV	V	VI
<i>A. Normal Ecg ..</i>	45	14	33	25	16	18	—	—	2	—	2	1
<i>B. Pathol. Ecg:</i>												
1. Rhyth. dist.	27	5	4	2	1	4	1	1	—	—	—	—
2. Conduc. » .	4	—	1	3	1	10	—	—	—	—	—	—
3. Coron. in- suff. (myo- card. affect. left hyper- troph., signs of infarct.)	3	7	11	7	8	32	—	—	1	—	2	2
4. Ryth.+con- duc. disturb.	—	1	—	—	—	4	—	—	—	—	—	—
5. Ryth. dist. + coron. in- suff. ....	5	5	—	3	2	3	—	—	—	—	—	—
6. Ryth.+con- duc. dist. + coron. in- suff. ....	—	—	—	—	—	2	—	—	—	—	—	—
7. Conduc.dist. + coron. in- suff. ....	—	—	1	1	9	4	—	2	—	—	—	—
Total path. Ecg:	39	18	17	16	21	59	1	3	3	—	4	3

offs from the chest, have not been employed. They might probably have aided in the detection of cases which are now concealed among the cardiographically normal cases. At least this should assumably be plausible with reference to Sec. II.

### Roentgenologic Examination of the Heart.

As earlier mentioned, in this material, only such operation cases have been included which have undergone at the clinic both preoperative electrocardiographic and roentgenologic examination because, especially from Danish and also from Swedish (TROELL) quarters it has been pointed out that both these investigations should be made in order to obtain a fairly clear apprehension of the heart's functional capacity. In estimating the normal size of the heart roentgenologically, the limit was put at 350 ml/m<sup>2</sup> for women and 400 for men (KJELLBERG). This obviously

involves schematization as, of course, even in each case, regard should be paid to the individual's age, work and, hence, the contingent probable size of the heart, etc. This consideration has not been accomplishable here however.

*Rtg changes.*

	Cases with no postop. heart changes						Cases with postop. heart changes					
	Group						Group					
	I	II	III	IV	V	VI	I	II	III	IV	V	VI
Normal rtg (= ♀ < 350 ml/m <sup>2</sup> , ♂ < 400 ml/m <sup>2</sup> )	62	16	25	29	25	36	—	—	1	—	2	1
Gen. enlargem. . .	20	11	17	12	9	34	1	2	1	—	1	1
Gen. enlargem. + Pericard. calcu- losa . . . . .	—	—	—	—	—	—	—	1	—	—	—	—
Posterior. enlarg..	3	—	—	—	—	—	—	—	—	—	—	—
Hyperton. heart .	—	—	—	1	—	—	—	—	—	—	—	—
Right and left en- largement . . . .	1	—	—	—	—	—	—	—	—	—	—	—
Rt., lft. and poste- rior enlargem.	—	—	—	—	—	—	—	—	—	1	—	—
Myocarditis . . .	—	—	—	—	—	—	—	—	—	—	—	—
Slight dilat. . . .	—	1	—	—	—	—	—	—	—	—	—	—
Left enlargement	8	9	12	4	17	26	1	1	1	1	1	1
Left and posterior enlargement . . .	3	2	—	1	2	1	—	—	—	—	—	—

Normal heart rtg in Sec. I occurred as follows: Groups I: 62, II: 16, III: 25, IV: 29, V: 25 and VI: 36. General enlargement of cor has a greater frequency in this material than left enlargement with the exception of Group V. In Sec. II rtg was normal in 4 cases (Group III: 1 case, Group 5: 2 cases, and Group VI: 1 case). The other cases are equally distributed on the whole between general and left enlargement.

### Pre- and Postoperative Diagnosis of Cardiac Changes.

As it can be of interest to ascertain to what extent the cardiac changes were certified pre- and postoperatively resp., and whether only these postoperative changes or further postoperative changes were discovered, an investigation of the same was made and the results are reported in the Table below.

*Pre- and postoperative diagnosticated cardiac changes.*

	Group I	Group II	Group III	Group IV	Group V	Group VI
No pre- or postop. cardiac changes..	20	2	8	21	9	7
Preop. diagnos. car- diac changes ....	80	40	48	28	48	93
Postop. addit. car- diac changes ....	—	—	—	2	—	—
Only postop. cardiac changes .....	—	—	1	—	—	—

It was found that in the cases where cardiac changes occurred, these were practically always discovered preoperatively in every group. Only in 1 case (Group 3) had postoperative cardiac changes manifested and in 2 cases (Group 4) further postoperative cardiac changes occurred.

**Preoperative Heart Medication.**

	Cases with no postop. heart complic.						Cases with postop. heart complic.					
	G r o u p						G r o u p					
	I	II	III	IV	V	VI	I	II	III	IV	V	VI
No medication .....	94	26	47	42	45	75	2	1	1	2	2	1
Heart glycosides .....	1	1	2	2	2	2	—	2	1	—	—	1
For vascul. dilat. ....	—	2	2	2	1	11	—	—	—	—	1	—
Sedatives .....	1	—	—	—	—	—	—	—	—	—	—	—
«Heart tonics» .....	—	—	—	—	1	—	—	—	—	—	—	—
Heart glycosides + vascul. dilat. ....	1	6	1	—	1	6	—	—	1	—	—	—
Heart glycosides + heart tonics	—	2	1	—	1	—	—	1	—	—	—	—
Heart glycosides + medic. for vascul. dilat. + sedatives ...	—	1	—	—	—	—	—	—	—	—	—	—
Heart glycosides + medic. for vascul. dilat. + heart tonic	1	—	—	—	—	—	—	—	—	—	—	—
Intraven. infusion or perm. infusion .....	—	—	—	1	—	—	—	—	—	—	—	1
Ditto + heart glycosides .....	—	—	—	—	1	—	—	—	—	—	—	—
Bld. transfusion .....	—	—	1	—	2	—	—	—	—	1	—	—
Ditto + intraven. infus. ....	—	—	—	—	—	1	—	—	—	—	—	—
Ditto + medic. for vascul. dilat. ....	—	—	—	—	—	1	—	—	—	—	—	—
Serum + heart tonics .....	—	—	—	—	—	1	—	—	—	—	—	—

Preoperative heart medication has been administered on varying indications in a number of cases. No medication was given in Sec. I according to the following: Groups I: 94, II: 26, III: 47, IV: 42,



V: 45 and VI: 75 cases. The heart medication administered in the other cases included vascular dilatants (18 cases), heart glycosides + vascular dilatants (15 cases) and heart glycosides alone (10 cases). Preoperative heart medication is also relatively rare in Sec. II (no medication in 9 cases. Heart glycoside was otherwise most frequently administered (4 cases).

### Comparative Investigation Regarding the Operation Cases with Reference to Anamnesis, Physical Finds, Ecg and Rtg.

In order to achieve some conception of the value of anamnesis and physical examination of the heart on the one hand, and of ecg and rtg, on the other, the material was distributed in two groups: (1) anamnestic—physically normal cor, (2) anamnestic—physically pathologic cor. The Table below reveals the condition of the various groups in the two sections with reference to ecg and rtg.

*The condition of the operation cases with reference to anamnesis, physical-diagnostic finds, ecg and rtg.*

	Anamn.-phys. norm. cor.						Anamn.-phys. path. cor.					
	Group						Group					
	I	II	III	IV	V	VI	I	II	III	IV	V	VI
I. Ecg and rtg normal . . . . .	9	—	8	11	6	5	25	8	8	9	9	7
II. 1. Ecg and rtg path. . . . .	2	1	—	1	2	3	22	18	15	11	14	52
2. Ecg path. rtg normal.	2	—	—	2	—	5	27	9	7	10	17	21
3. Ecg normal rtg path. . . . .	1	—	3	3	1	1	11	6	16	2	2	6

It is seen that within the anamnestic—physically normal group the ecg and rtg were normal in 39 cases, ecg and rtg pathologic in 9 cases, ecg pathologic and rtg normal in 9 cases and finally ecg normal and rtg pathologic in 9 cases. Accordingly, in this material of "normal cases" no reliable result has been achieved in favour of the value of either one or the other method of investigation. In the anamnestic—physically pathologic group the ecg and rtg are found normal in altogether 66 cases, ecg and rtg pathologic in 132 cases, ecg pathologic and rtg normal in 81 cases and ecg normal

and rtg pathologie in 43 cases. It would thus seem that eeg has been more reliably decisive in this group than rtg. It should be clear from this analysis, what also must be considered as an essential fact in this investigation, that it is only by taking into consideration both the anamnestic-physical finds (and especially the former), and by examining with eeg and rtg that a fairly reliable judgment of the functional capacity of the heart can be formed.

### Anaesthesia and Postoperative Heart Complications.

Not only does the operative trauma itself play a rôle in the question of burdening the heart but, undoubtedly, and to some great extent, also does the anaesthesia. To a greater extent than the anaesthetic itself is involved, is the manner in which it is administered. The following Table illucidates the condition between the anaesthetic and number of cases of postoperative cardiac complications. Unfortunately information as to which anaesthetic was used in 5 cases, is lacking.

*Forms of anaesthetic used.*

Anaesthetics	Cases with no postop. heart complic.						Cases with postop. heart complic.					
	G r o u p						G r o u p					
	I	II	III	IV	V	VI	I	II	III	IV	V	VI
Not reported ....	—	14	4	11	12	20	—	1 <sup>(9)</sup>	1 <sup>(3)</sup>	1 <sup>(1)</sup>	1 <sup>(11)</sup>	1 <sup>(16)</sup>
Not reported (intubation) .....	2	—	—	—	—	—	—	—	—	—	—	—
Ether .....	—	—	1	—	1	—	—	—	—	—	—	—
Local anaesth. ....	92	1	—	—	1	3	2 <sup>(14)</sup> (15)	1 <sup>(6)</sup>	—	—	—	—
Loc. an. + narco- tal. ....	1	—	—	2	6	1	—	—	—	—	—	—
Loc. an. + narco- tal + N <sub>2</sub> O — O <sub>2</sub> + ether. ....	—	—	1	—	—	—	—	—	—	—	—	—
Loc. an. + percaine + ether + O <sub>2</sub> .	—	—	1	—	—	—	—	—	—	—	—	—
Loc. an. + narco- tal + C <sub>3</sub> H <sub>6</sub> ....	—	1	—	—	—	—	—	—	—	—	—	—
Loc. an. + narco- tal + N <sub>2</sub> O-O <sub>2</sub> ..	1	—	—	—	1	1	—	—	—	—	—	—

(1) = 2453/42,

(2) = 1597/40,

(3) = 836/42,

(4) = 2536/40,

(5) = 2265/40,

(6) = 1680/41,

(7) = 2469/41—2014/43,

(8) = 2065/43—2244/43,

(9) = 642/41,

(10) = 1151/43,

(11) = 3399/43—3496/43,

(12) = 2114/42,

(13) = 2492/42,

(14) = 1452/40,

(15) = 673/44,

(16) = 1303/42,

(17) = 2821/42,

(18) = 2184/41—771/43.

(cont.)

	Cases with no postop. heart complic.						Cases with postop. heart complic.					
	Group						Group					
	I	II	III	IV	V	VI	I	II	III	IV	V	VI
Lba=(Percaine or novocaine 5% or decicaine).....	—	—	5	6	13	46	—	—	1 <sup>(4)</sup>	—	—	1 <sup>(18)</sup>
Lba + narcotal ..	—	—	7	5	7	12	—	—	—	—	2 <sup>(12)</sup> (13)	—
Lba + narcotal + N <sub>2</sub> O-O <sub>2</sub> .....	—	—	14	10	8	1	—	—	—	—	1 <sup>(10)</sup>	—
Lba + narcotal + C <sub>3</sub> H <sub>6</sub> .....	—	—	—	1	—	—	—	—	—	—	—	—
Lba + citodon + N <sub>2</sub> O-O <sub>2</sub> .....	—	—	—	1	—	—	—	—	—	—	—	—
Lba + N <sub>2</sub> O-O <sub>2</sub> ..	—	—	4	—	1	2	—	—	—	—	—	1 <sup>(17)</sup>
Lba + narcotal + ether .....	—	—	—	—	1	—	—	—	—	—	—	—
Lba + loc. a. ....	—	—	—	—	1	1	—	—	—	—	—	—
Lba + N <sub>2</sub> O-O <sub>2</sub> + ether .....	—	—	1	—	1	—	—	—	—	—	—	—
Narcotal .....	—	2	—	—	—	1	—	—	—	—	—	—
Narcotal + ether.	—	—	1	—	—	—	—	—	—	—	—	—
Narcotal+N <sub>2</sub> O-O <sub>2</sub>	1	16	3	4	1	3	—	1 <sup>(8)</sup>	—	—	—	—
Narcotal+C <sub>3</sub> H <sub>6</sub> ...	—	1	5	—	—	—	—	1 <sup>(7)</sup>	—	1 <sup>(2)</sup>	—	—
Narcotal + C <sub>3</sub> H <sub>6</sub> (intubation) ...	—	—	—	3	—	—	—	—	—	—	—	—
Narcotal+N <sub>2</sub> O-O <sub>2</sub> + ether .....	1	—	4	2	—	4	—	—	—	—	—	—
Narcotal+N <sub>2</sub> O-O <sub>2</sub> + ether (intubation) .....	1	—	—	—	—	—	—	—	—	—	—	—
N <sub>2</sub> O-O <sub>2</sub> .....	—	1	3	—	—	2	—	—	1 <sup>(5)</sup>	—	—	—
N <sub>2</sub> O-O <sub>2</sub> + ether ..	—	2	—	2	—	—	—	—	—	—	—	—

The greatest number of cases with postoperative heart complications have occurred on the administration of lumbar anaesthetic (percaïne 1/1500, decicaine or novocaine) + narcotal (2 cases) and narcotal + N<sub>2</sub>O-O<sub>2</sub> (1 case) resp. Characteristic of the difficulty in judging the effect of the anaesthetic in this connection is however that 3 of the postoperative heart complications (of which 2 with lethal issue) occurred on the administration of local anaesthetic. The narcotic had probably nothing to do with the lethal outcome of the two cases of death (thyreotoxic crisis).

### Types of the Postoperative Heart Complications.

The clinical finds made in the cases which progressed with both lethal and non-lethal heart complications are reproduced in the following Table.

*Postoperative heart complications.*

	Non-lethal course.						Lethal course.					
	Group						Group					
	I	II	III	IV	V	VI	I	II	III	IV	V	VI
I. <i>Clin. norm. cor</i> .....	—	—	1	—	—	—	—	—	—	—	—	—
II. <i>Clin. path. cor:</i>												
Cyanos. + Heller + .....	—	—	—	—	—	—	—	—	—	—	—	1
Cyanos., dysp., edem., systol. mur., card. enlarg., intraventr. condu. disturb. + coron. insuff. + infaret.?? ..	—	—	—	—	—	—	—	1	—	—	—	—
Hollow tones + gen. enlarg. + myocard. injuries .....	—	—	—	—	—	1	—	—	—	—	—	—
Hollow. tones, hypert. left prepond. vestib. enlarg....	—	—	—	1	—	—	—	—	—	—	—	—
Dysp. + ex. systol. + left enlarg. ....	—	—	—	—	—	—	—	—	1	—	—	—
Dysp. + tachyc. + tingl. in precord. + edema + nyctur. + cyanos. + syst. mur. + hypertoni. + left hypertro. + left myocard. injur.	—	—	—	—	—	—	—	—	—	—	—	—
Dysp., tachyc., cyanos., ex. syst., syst. mur. ....	—	—	—	—	—	—	—	—	—	—	1	—
Dysp. + edem. + hol. tones + left prepond. + coron. insuff. N.P.N. 52 mg% ...	—	—	—	—	—	—	—	—	—	—	1	—
Hypertonia .....	—	—	—	—	—	—	—	1	—	—	—	—
Hypert., syst. mur. A <sub>2</sub> aec.	—	—	—	—	—	—	—	—	—	—	1	—
Hypert. + tachyc., left enlarg., left prepond. ....	—	1	—	—	—	—	—	—	—	—	—	—
Nyctur., hol. tones, myocard., laevogram .....	—	—	—	1	—	—	—	—	—	—	—	—
Some gen. enlarg. N.P.N. 43 mg% .....	—	—	—	—	—	—	—	—	—	—	1	—
Pericard. calei. (cyanos., dysp., edem., ascit., cough, fibrillation) .....	—	—	—	—	—	—	—	1	—	—	—	—
Syst. mur., left enlarg. + left prepond. + coron. insuff.? .....	—	—	—	—	1	—	—	—	—	—	—	—
Tachyc. + dysp. syst. mur. + sinus tachyc. + left enlarg. ....	—	—	—	—	—	—	1	—	—	—	—	—
Tachyc. + syst. mur. + left prepond. + gen. enlarg.	—	—	—	—	—	—	1	—	—	—	—	—
Tachyc. + syst. mur. ....	1	—	—	—	—	—	—	—	—	—	—	—
Left enlarg. + left prepond. + coron. insuff. ....	—	—	—	—	—	—	—	—	—	—	—	1

In cases where the heart was clinically (both anamnesticall-physically, and with ecg and rtg examination) normal, only 1 case (Group III) of postoperative heart complication occurred,

*Postoperative heart complications and their treatment.*

Complication	Number	Therapy	Effect	Remarks
<i>Group I.</i> <i>Number of cases: 2.</i>				
Thyreotoxie crisis .....	1452/40	Intraven. perm. infus. with glycos	Mors	Mors in thyreotoxie crisis
Thyreotoxie crisis .....	673/44	—	Mors	Mors in thyreotoxie crisis the day after operation. Autopsy: Gen. dilata. cor. Weight: 400 gr. slight arterioscler. in aa. coronariae
<i>Group II.</i> <i>Number of cases: 4.</i>				
Insufficiencia cordis .....	1680/41	—	Mors sub.	P.A.D. Cardioart.scl. grav. + ca. mam. sin. op. + pneumonia. Cause of death: pneumonia + insuff. cordis
Insufficiencia cordis .....	2469/41— 2014/43	Intrav. perm. infus. + O <sub>2</sub>	Mors	Pericardit. calc. op. P.A.D.: Polyserositis pericard. Myo- and endocard. resembl. Aa. coronariae: 0
Insufficiencia cordis .....	2065— 2244/43	Digitalis + O <sub>2</sub>	Mors sub.	P.A.D.: Immediate cause of death: card. insuff. Myocard.: 0
Paroxysmal tachycardia ...	642/44	Digitalis	+	
<i>Group III.</i> <i>Number of cases: 3.</i>				
Insufficiencia cordis .....	2265/40	—	Mors	P.A.D.: Ca. hepat. + cirrhos. hepat. + pancreat. chron. + thromb. v. port. vet. et cavae inf. rec. c. embolia et infarct. pulm. + cardiosclerosis
Shock .....	2536/40	Coramine + efedrine + intrav. perm. infus. (NaCl) + blood transf.	+	

Complication	Number	Therapy	Effect	Remarks
Infaret. myo-card. ....	836/42	Theophyllamine + hepar. + fenc-mal + nitro-glyc. + diucardine	+	
<i>Group IV.</i> <i>Number of cases: 2.</i>				
Shock .....	1597/40	Intrav. perm. infus. + blood + heart tonic	+	
Fibrillation ....	2453/43	Intrav. perm. infus. + digital. + heart tonic + quinidine	+	
<i>Group V.</i> <i>Number of cases: 4.</i>				
Insuff. cordis ..	2114/42	Intrav. perm. infus. + blood transf. + digital	Mors	Autop.: Immediate cause of death: insuff. cordis. Cor. dilat. Myocard. Non-charac. Slight atheromat. in the coron. arter.
Insuff. cordis ..	2482/42	Intrav. perm. infus. + blood trans. + digit. + nicetamide	Mors	Autop.: Immediate cause of death: peritonit. diff. purulenta
Insuff. cordis ..	1151/43	Blood transfusions	Mors	Autop.: Peritonit.ac. + infaret. sept. lob. inf. pulm. dx. Immediate cause of death: Insuff. cordis
Infaret. cordis .	3399/43— 3496/43	Nicetamide + strophanthus	Mors	Clinic: Card. insuff. Autop.: Immediate cause of death: Card. infaret.
<i>Group VI.</i> <i>Number of cases: 3.</i>				
Infaret. cordis .	2181/41— 771/43	Coffeine + theophyllamine	+	
Insuff. circula .	1303/42	Digital. nicetamide, diucardine, sympametine. Intrav. perm. inf. (glycose + NaCl)	Mors	Cause: Bronchopneumonia. Death from suffocation. No autop.
Operation shock	2821/42	Blood transfusion	Mors	Autop.: Tumour ren., caval stoppage + op. shock

and in this case the issue was not lethal. The other cases distribute themselves within different groups of symptom complex. The number of postoperative heart complications have been in Groups

I: 2, II: 4, III: 3, IV: 2, V: 4 and VI: 3 cases. In 7 cases the trouble was insufficiencia cordis, in 3 shock, in 3 infarction, in 2 thyrotoxic crisis (which has been included here, as this disease is connected with the circulation to a great extent), and in each, 1 case of fibrillation, insufficiencia circulationis and paroxysmal tachycardia. The treatment in the different cases included intravenous permanent infusions, blood transfusion, digitalis-strofantus and stimulantia as well as  $O_2$ . The Table following gives a report of the same and illucidates that the treatment in 6 cases led to the desired result, also, that in spite of treatment in 2 cases the lethal outcome could not be averted.

### An Account of the Cases in the Analysed Material which had a Lethal Course Due to Heart Complications.

#### Group I. 2 cases.

1452/40. Woman, aged 63. Struma toxica nodosa intrathoracalis. Anamnesis: Tachycardia, dyspnoea. Phys.: Beat strengthened. Systol. mur. P. 96. Bas. met. + 46 %. Ecg 1410: Sinus tachycard. Rtg: moderate left enlarg. Op.: Subtotal strumectomy. Loc. an. Postop. therapy: Intraven. perm. drop with glycos. Mors 3 days after op. Clinic: Thyrotoxic crisis. Autop.: 0.

673/44. Woman, aged 53. Struma toxica.

Anamn.: Severe tachycard. Phys.: Slight systol. mur. tachycard. Ecg (1400): Left prepond. Rtg.: Vol. 440 ml/m<sup>2</sup> (slight enlarg.). Preop. ther.: Lugol 2 weeks, bas. met. is reduced from + 32 % to + 18 %. Op.: Subtotal strumectomy. Loc. an. Mors in thyrotoxic crisis the day foll. op. Autop.: Gen. dilata. cor. Weight 400 gr. Slight coron. arterioscler.

#### Group II. 3 cases.

1680/41. Woman, aged 77. Cancer mammae sin. op. recur.

Anamn.: 0. Phys.: Hyperton. 175/80. Otherwise 0. Ecg (2527): Grave myocard. injur. Rt branch block. Cor rtg: Heart very enlarg. Diffuse calcif. in aorta. Vol. 900 + 650 ml/m<sup>2</sup>. No complaints of heart trouble from pat. therefore one decided to op. despite bad ecg and rtg. Preop. 1 amp. strophanthin. Op.: Extirp. of the canc. Loc. an. 20.30 o'cl. op. day, normal. 22.15, pat. is dead. Autop.: Cardioarterioscler. grav. + incip. pneumonia. No sign of metastasis. Cause of death: Pneumo. + insuff. cordis.

2469/41—2014/43. Woman, aged 30. Pericard. calc. op.

Anamn.: 1940, certified armoured heart. Therapy: Digital., novurite, diuretine. Laparocentes, rest. 1940, recurrent severe trouble: ascit. bone-edema, dysp. hydrothoraxis. Op. 1941 (K. S.). Cardiolyt.

Little improvement: short of breath, bone-edema, cough. Therapy: Repeated laparocentes., digital., salmine, novurite. Phys.: rest-edema, sacraledema. Fibrill. wave beat. Liver palp. 2 fing.br. below arcus. Blood press. P. 92. H. + Esb. 20 ‰. Ecg (3365 and 3491): Fibrill. + small crupt. Rtg: armour. heart, card. enlarg. (+ plenra exud.). Preop. therapy: See above. Op.: accord. to Talma. Anaes.:  $C_3H_6$  + narcotal. Postop. therapy: Intrav. infus. +  $O_2$ . Endured op. well. Day after rise of temp. P. 100. Fibrill. aryth. Dysp. Died 5 days after op. from card. insuff. Autop.: Main disease: Polyserosit. Pericard: calci pericard. Myocard.: 0. Endocard.: Somewhat thickened. Aa. coronar.: 0. Pronounced liver cirrhos.

2065/43—2244/43. Woman, aged 60. Canc. mam. sin. + strum. diff. tox.

Anamn.: Motorial dysp. and often tachycard. since the spring of 1942. Ankles swell in the evening. Phys.: Lip-cyanos., rest-dysp. bone-edema. Syst. mur. above the whole heart. Blood press.: Normal. P. 112. H.: —. Ecg (2467): Intravent. conduc. disturb. + coron. insuff. + infarct.? Cor rtg.: Gen. enlarg. Lung stas. Vol.: 980 ml = 600 ml/m<sup>2</sup>. Preop.: Digital. and treatment at med. clin. (digital., nicitam. phenemal). Hyperthyreos. (Bas. met.) is considered more causal to cardiac symptoms than cor. Radiolog. urge quick op. therefore after Lugol treatment the op. is performed: Ablatio + exacresis axillaris. Narcotal +  $N_2O-O_2$ . Postop. digital. +  $O_2$ . Acute death with clin. pict. of insuff. cordis, the 20th day after op. Autop.: Immed. cause of death: Insuff. eordis. Myocard.: 0.

### Group III. 1 case.

2265/40. Man. Aged 68 years. Icterus.

Anamn.: Shortness of breath on going uphill the last year. Extra systol. Phys.: 0. Ecg (2684): Bradycard. 0 path. certain. Cor rtg: moderate hypertr. of left auricul. and moder. diff. dilat. of aorta. Large strong pulsat. of left auricul. contour, of aorta asc. and of the aorta bud. Vol.: 550 cc/m<sup>2</sup>. Med. consult.: extra systol. Preop. 15 dr. of pandigal 3 times during 3 days. Op.: Laparot. expl. + cholecystoduodenost. + cholangiograph. + drainage + cig. Died 20 days after op. Clinic.: Heart weakness. Autop.: Cancer hepatis + cirrhosis hepat. et pancreat. chron. + thrombosis v. portae veter. et cavac inf. recens c. embolia et infarct. pulm. + cardiosclerosis.

### Group IV. 0 case.

### Group V. 3 cases.

2114/42. Man, aged 54. Cancer coli.

Anamn.: 0. Phys.: N.P.N. 43 mg‰. Ecg (3562): 0. Rtg.: Vol. 420 ml/m<sup>2</sup>. Preop. therapy: Theophyllamine. Op.: Resectio ileocecalis + transverse ileostomy. Lumb. an. + narcotal. Postop. therap.: Intrav. perm. infus. + blood trans. + digital. Postop. abscess in op. region + pneu-



mon. Died 32 days after op. Autop.: Immed. death cause: Insuff. cordis. Cor 335 g. Dilat. Myoeard. non-char. slight atheromat. in a. coron.

*1151/43.* Man, 75 years of age. Cancer coli transv.

Anamn.: Tired and short of breath on exertion, ankle-edema. Phys.: Hol. tones. RN 52 mg%. Ecg (1994): Left prepond. + coron. insuff.? Rtg.: 0. Pre- and postop. therapy: Blood transf. Op.: Rad. with resect. of colon transversum and descendens. Anastom. side to side. Resec. of small intest. Anastom. to the side. Resec. of a part of the curvat. maj. portion of the ventric. Lumb. an. + narcotal +  $N_2O-O_2$ . Died 6 days after op. Autop.: Stat. postop. + peritonit. ac. + infarct. sept. lob. inf. pulm. dx. + insuff. cordis. Autop.: Stat. post op. adenocarcino. coli-transv. + peritonit. ac. (suture insuff.) + infarct. sept. lob. inf. pulm. dx. + insuff. cordis.

*3399—3496/43.* Man, aged 65 years. Cancer recti.

Anamn.: Anginoid pains 6—7 years ago. After medic. free from the trouble. Hyperton. for 3 years. Phys.: Prolonged syst. mur. above apex.  $A_2$  acc. Blood press. 170/90. Ecg (5910): 0. Rtg. 0. Op.: Abdominosacral rectum extirp. Séance I. Anaes.? Mors 4 days after op. Pict.: card. insuff. Autop.: Immediate cause of death: Cardiac infarction.

#### *Group VI. 2 cases.*

*1303/42.* Man, aged 84. Tumor vesicae urinae.

Anamn. Occas. pain in region of the heart. Phys.: Presumpt. lip-cyanos. Blood press. 155/85. Heller: signs. Ecg (2295): 0. Rtg. 9. Preop. therapy: 0. Op.: Extirp. of tumour in the bladder + insertion of radium needles. Anaes.? Postop.: Fibrill. with rapid extra systol. arhythm. Intern. consult: Hol. tones. Probable auricular fibrillation. Postop. therapy: Digital. nicetamide, intrav. perm. infus. with glyc. and NaCl, coffein, diucardine, sympametine. Died 3 weeks after op. in circul. insuff. due to bronchopneumo. Pict.: suffocation. No autopsy.

*2821/42.* Man, aged 37. Adenocarcinoma ren. dx.

Anamn.: 0. Phys.: 0. Ecg (4720): Left prepond. + coron. insuff. Rtg.: 460 ml/m<sup>2</sup>. Suspicion of destruc. in left auric. Preop. therapy: coffein. During op.: Blood transf. in connection with decrease in bl. press. (pat. warm and dry all the time). Op.: (1) Explorative exposure of the right kidney. Anaes.: lumb. + gas. Trickling hemorrhage cause of op. Renewed tamponade. Anaes.? Blood transf. in connection with the renewed op. Despite the transfusions and stimulation with coffein and coramine the bl. press. does not rise. P. small and weak. Bl. press. remains at 50—60. Another transf. on the evening of the op. day. Nausea during the transfusion. Is severely affected. Pale with very weak pulse. Suddenly worse and mors the day after the operation. Autop.: Tumour ren. + caval obst. + operation shock.

# Number of Cases with Lethal Course in the Analysed Material and in the Operation Material on the Whole.

## Number of lethal cases.

	In the analysed material.						In the op. mat. on the whole
	G r o u p						
	I	II	III	IV	V	VI	
I. <i>With cardiovascular death casuses or causes contrib. to death</i>							
1940 .....	1	—	1	—	—	—	7
1941 .....	—	2	—	—	—	—	15
1942 .....	—	—	—	—	2	2	10
1943 .....	—	1	—	—	2	—	10
1944 .....	1	—	—	—	—	—	12
II. <i>With other causes of death.</i>							
1940 .....	1	—	1	—	—	—	43
1941 .....	—	—	—	1	2	—	50
1942 .....	—	—	—	3	2	2	52
1943 .....	—	—	—	—	2	—	38
1944 .....	—	—	—	1	2	—	42

Number of cases at the clinic during different years.

1940: 2708

1941: 3436

1942: 3563

1943: 3807

1944: 3596.

The above Table gives a report on the cases in the various groups contained in both the analysed material and operation-material on the whole which had a lethal course with cardiovascular and other causes of death, during the period 1940—1944. The Table discloses that in the analysed material the greatest number of deaths occurred due to cardiovascular or contributive cardiovascular causes within Group V (4 cases) and Group II (3 cases) respectively during 1942 (4 cases) and 1943 (3 cases). In the operation material on the whole there occurred the greatest number of deaths from the above cause, in 1941 (15 cases) and in 1944 (12 cases). In the analysed material during a period of 1940—1944 there occurred altogether 12 cases with the above cardiovascular or contributive cardiovascular cause of death, and in the operation material on the whole, 54 cases. Other causes of death have been reported in 17 cases in our material, and in the operation material

on the whole, in 225 cases. The total operation mortality for a 5 years' period is thus 279 cases.

### Time at which the Postoperative Cardiovascular Deaths Occurred.

Cases of death, in which, in our material could be certified that cardiovascular or contributive cardiovascular cause of death had occurred on the following days:

#### *After the operation.*

Op. day .....	1 (Group I)
1 » after .....	2 (Groups I and VI)
3 days » .....	1 (Group I)
4 » » .....	1 (Group V)
5 » » .....	1 (Group II)
6 » » .....	1 (Group V)
20 » » .....	1 (Group II)
21 » » .....	1 (Group VI)
24 » » .....	1 (Group III)
32 » » .....	1 (Group V)

### Summary.

After an introductory report on some of the most important works which have been published of recent years with reference to the value of preoperative heart examination, the present author gives an account of the analysis of a material from the Surgical Clinic of the Karolinska sjukhuset during the 5 years' period 1940—1944. The material includes 406 operation cases in consecutive order which were preoperatively examined with both ecg and heart rtg. The cases have been distributed with reference to organ, into 6 groups with a max. 100 cases in each, and cases which proceeded with postoperative complications have been kept apart. An account is also rendered in the form of tables revealing the conditions of the material in respect of age and sex, anamnestic, physical-diagnostic and laboratory finds as well as ecg and heart rtg finds. Moreover, the extent to which heart changes were preoperatively certified has been investigated, likewise the kind of medicament employed and the frequency of its administration. A comparative study of the condition of the operation cases regarding anamnesis, physical finds, ecg and rtg has also been made,

as well as of the behaviour between the anaesthetic used and the postoperative heart complications. Finally a statement is given concerning the nature of the postoperative complications, the number of cases with lethal course and cardiovascular and other causes of death, and also the point of time at which death in the cardiovascular cases occurred. The investigation is considered to have shown that it is not possible through preoperative eeg and rtg examinations alone, in every case, to form a safe opinion of the state of the heart with reference to operative risk, but that the anamnestic-physical-diagnostic finds must to some extent also be taken into consideration. It is possible that the tests relative to the cardiac strain and eeg with combined take-offs from the chest, nowadays introduced, may be able to enhance the value of preoperative investigations.

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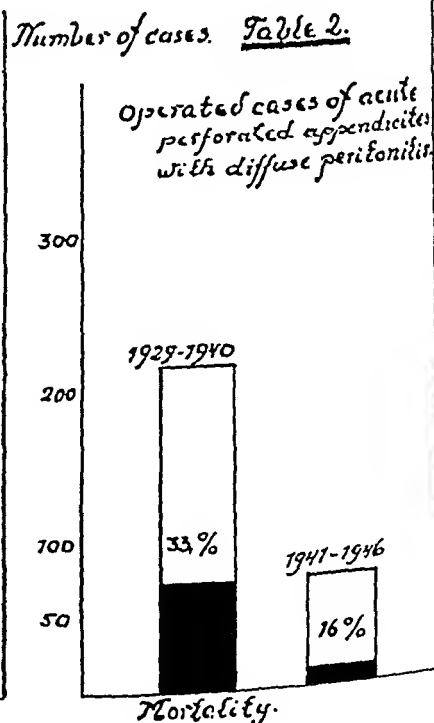
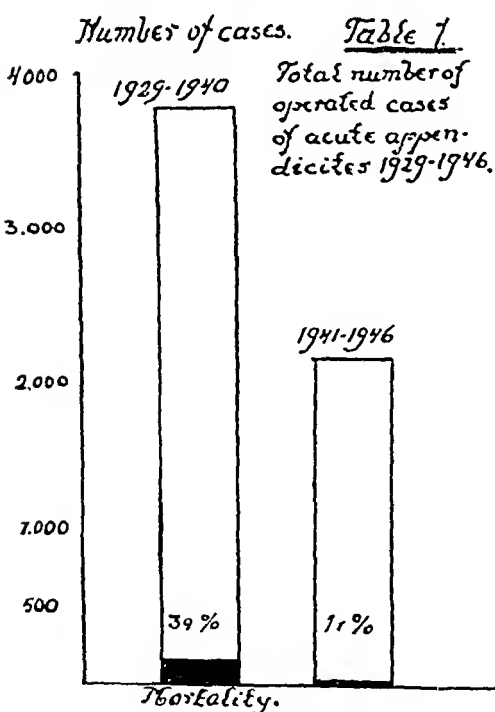
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## Septic Appendical Peritonitis and Fluid Balance.

By

T. HIERTONN.

During the last 15—20 years there has been much improvement in the results of operations for appendicitis. In the years 1929—1940 nearly 4,000 cases of acute destructive appendicitis were operated upon with a mortality of nearly 4 %; the following 6 years period 1941—1946 more than 2,000 cases with a mortality of about 1 %.



If we examine the severer cases of diffuse peritonitis from a ruptured appendix we can note a very distinct fall in the mortality, as Table 2 will show.

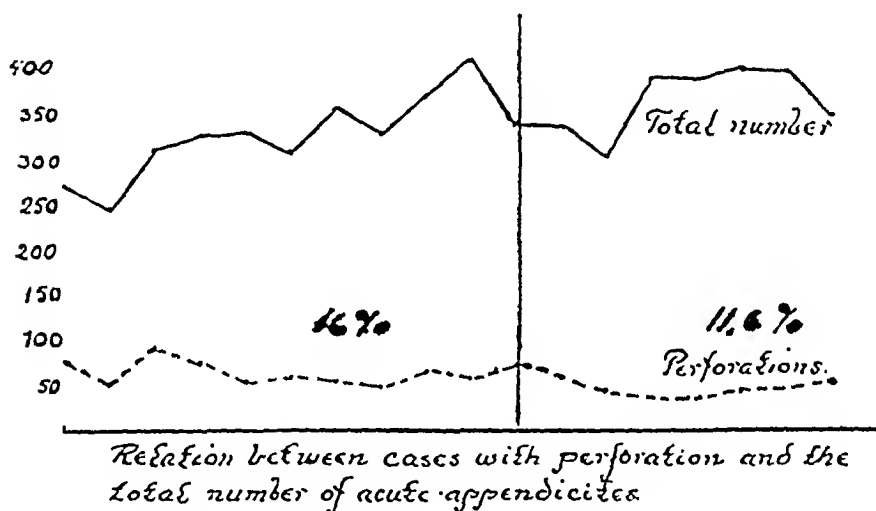
What factors can have caused this improvement?

1. Patients come perhaps earlier now-a-days to an operation which can take place at a more suitable moment. It is remarkable, however, that the number of cases of perforated appendicitis is constant from year to year.

Table 3

Number of  
cases

1929 30-31-32 33 34 35 36 37 38 39 40-41 42-43 44-45-46

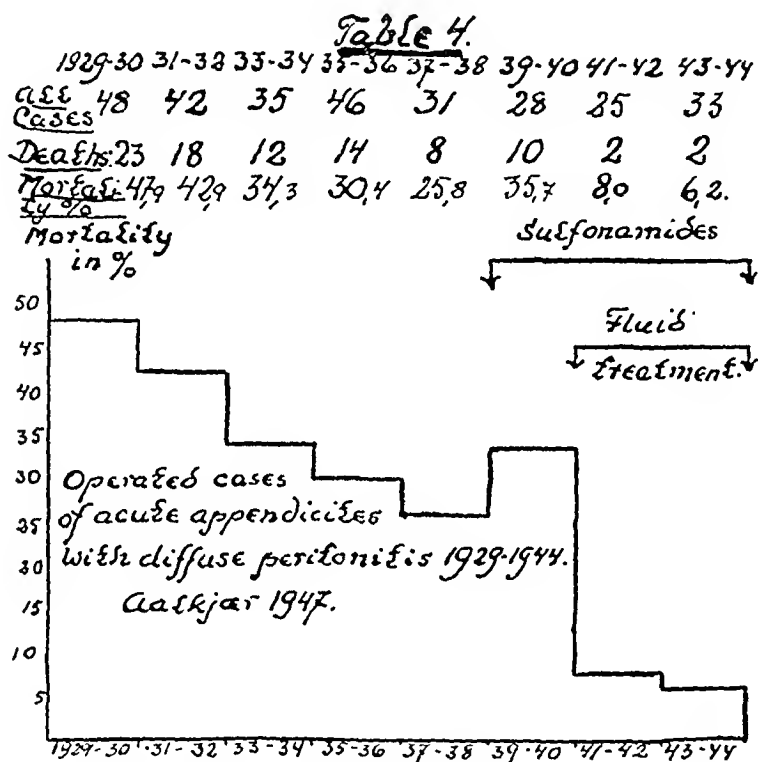


This table shows that there is only a slight fall in the number of perforations in relation to the total number of cases of acute appendicitis. This small difference 16 to 11.6 % cannot, however, explain the improvement.

2. The reasons for operation have been the same the whole time. That which has been very obviously changed is the post-operative treatment. The death-rate for the cases of diffuse peritonitis has for many years in Scandinavian and North European literature been between 30—50 % with an average of 33—35 %. The reason why statistics often show too favourable results is because the term diffuse peritonitis has not been clearly defined.

In this group we include only the cases which show clinical signs of illness — an increase of temperature, rapid pulse, tender-

ness and defence of the abdomen, disturbances in the peripheral circulation, meteorism and vomiting. There is pus in the abdomen without any tendency to limitation, a foul smell and bacteria in cultivation. With this strict classification AALKJAER has made a very interesting table from the Bispebjerg Hospital in Copenhagen.



As will appear from this table the mortality during the first 12 years (1929—1940) lies between 35 and 40 %. Chemo-therapy with sulfonamides was applied in 1939. There was no fall in the mortality. During the four years 1941—1944 when treatment with fluid combined with chemo-therapy was used the mortality average was 7.7 %.

The attempts which were made here to improve the bad prognosis of peritonitis show that the specific serum-treatment ad modum LÖHR did not meet our expectations. Only small doses were used at first, but from 1939 considerably larger doses of serum.

LINDAU's investigations show that the only bacteria which are of pathogen importance are coli. Therefore, a priori, result from sulfonamide might be expected. In many articles during recent

years a falling mortality is proclaimed a triumph for chemotherapy. In others sulphonamides are not considered of any importance at all. The truth may be said to lie between these extremes. Sulfonamide becomes inactive in the presence of pus and the actual value of the local application in the peritoneum is therefore doubtful. If the blood-concentration of sulfonamide is raised to 8—12 mg. % during 4—6 days treatment a certain prophylaxis for complications of the lungs may occur. If we look at our material a certain improvement can be noted but the curve is not pure and consequential chemo-therapy has not been accomplished. Therefore no conclusions can be drawn from these small figures. It is the same in the case of penicillin during the last 2 years.

As has been pointed out by different investigators and emphasized by BOHMANSSON in his opening lecture at the meeting of Nordisk Kirurgisk Förening in Copenhagen in 1935 severe septic peritonitis corresponds with the picture of a shock. It produces therefore hemoconcentration and diminution of the circulating quantity of blood. With increased experience of this during recent years we have attacked this factor by supplying fluid intravenously. Before 1941 we used only crystalloid solutions. In some cases they were sufficient momentarily to remove the peripheral disturbances of the circulation, but an overdose caused hypoproteinemia and hydremia with increased meteorism and even oedema. After 1941 a more individual fluid treatment has been used. Collaboration with the central laboratory and the determination of hematocrit, serum protein, alkali reserve, non-protein nitrogen, chlorides in the urine and so on have given us possibilities of analysing the degree of disturbance in the fluid balance and of dosing and individualising the fluid treatment.

Many of our cases illustrate the truth of the doctrine: Meteorism is not influenced by drugs, sera, enema or fistulas. The supreme remedy is blood or plasma. It is therefore a matter of attacking the circulatory disturbances and of restoring the circulating quantity of blood without at the same time causing a hydremia. The favourable result which was obtained by serum-therapy in larger doses ad modum LÖHR can perhaps be explained as pure influence of protein. By repeated analyses at the laboratory and adequate supplies of fluid we try to avoid dehydration as well as hydremia. On symptoms of hypocholeremia which follow vomiting sodium chloride is given in isotone or hypertone solution and on

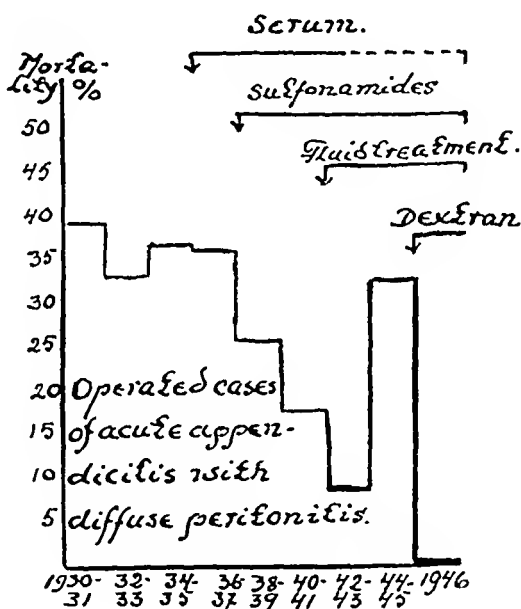


acidosis in septic diarrhea and intestinal fistula bicarbonate is injected in 1.3 % solution intravenously.

Having had these analyses at our disposal and adjusted our fluid treatment accordingly the result shapes itself in the following manner.

Table 5.

	1930-31	32-33	34-35	36-37	38-39	40-41	42-43	44-45	1946
all cases	27	49	44	25	28	23	25	22	18
Deaths	14	16	18	9	7	4	2	7	0
Mortality %	51.9	32.7	40.9	36.0	25.0	17.4	8.0	31.8	—



As the table points out, a distinct decrease of the mortality occurs during the first years, exactly similar to the statistics of AALKJAER. However, in 1944—1945 there are 7 deaths in 22 cases.

Cases I—III are "bad cases", i. e. old patients coming late for the operation. The post-mortem examination show diffuse peritonitis and bronchopneumonia.

Cases IV—V: males, 52 and 60 years old, died of uremia.

Case VI: male, 52 years old. Diabetes mellitus with diffuse peritonitis and empyema of the chest.

Case VII: female, 31 years old, having been operated after more than 3 days illness. Death after 3 weeks. Diffuse peritonitis.

In 1946 there was no death in 18 cases of diffuse appendical peritonitis. The experiences of the last few years from other directions also (AALKJAER) tell us that practically every case can be saved from death in the peripheral circulatory disturbances in the first stages of peritonitis by an adequate supply of fluid winning time by this means for other measures; chemo-therapy and the treatment of other complications such as ileus and abscesses.

According to our statistic the mortality during the first few days of the illness has diminished during recent years. If the cases of death are analysed it is now only in rare cases that the primary shock cannot be overcome by a fluid treatment. During earlier periods nearly half of the deaths were caused by the primary circulatory disturbances. As AALKJAER shows, those patients who have survived the first critical days, on the one hand have greater possibilities than before of getting complications in the form of ileus or internal abdominal abscesses. On the other hand many cases recover without any complications at all. In late stadium of peritonitis a certain increase of ileus can be noticed in our material during the last few years. In these cases one may observe favourable results with repeated doses of *tinctura opii* as conservative treatment.

BACKER-GRØNDAHL, who elaborated that method and consequently practiced it since 1917, recommends to venture no relaparotomy without preceding it, within 1 or 2 days, by administration of opium. According also to our own experience, one could avoid in that way a great number of relaparotomies.

Pain, occurring in postoperative ileus is due to difficult gastro-enteric passage (oedema, adhesions and bend-formations).

These pains correspond to animated, cramp-like intestinal movements, succeeding distension by gas. For a rather considerable space of time, that state remains reversible. If one damps the intestinal "panic" movements, intestines may physiologically empty by themselves. One is likely to obtain the above-mentioned effect by administration of *small* doses of opium, diminishing thus only acute intestinal movements ("panic" movements) without any risk for paralysing disturbances.

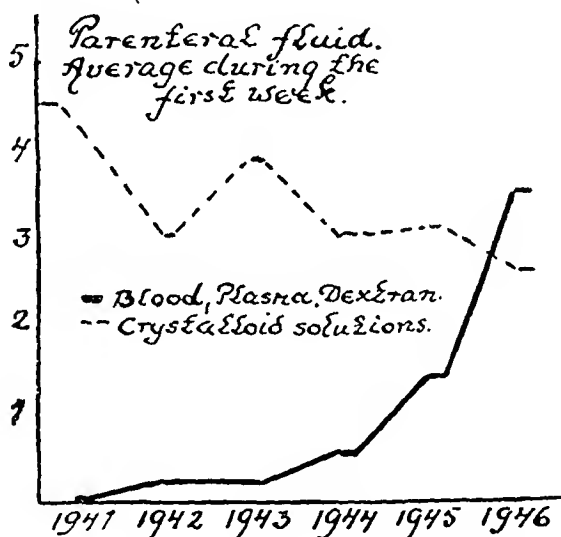
2—3 drops of tinct. opii shall be given as soon as the patient has pain and as often as necessary, to calm the intestine. Ordinarily, 3—5 times a day will be sufficient. Auscultation will control, whether permissible doses risk to be depassed; in fact, peri-

staltism must remain detectable. If, however, either strangulation or volvulus occur, those small doses of opium will be of no effect. If, moreover, X-ray detects progress of the ileus picture, relaparotomy has to be considered.

Regarding the transfusion remedies which are used here, a definite change has taken place. We have used greater and greater doses and more and more transfusions. During 1946, four times as much blood and plasma was given than in 1941 and on the average every patient was given during the first week nearly 4 liters of blood, plasma and dextran.

Table 6.

Liters.



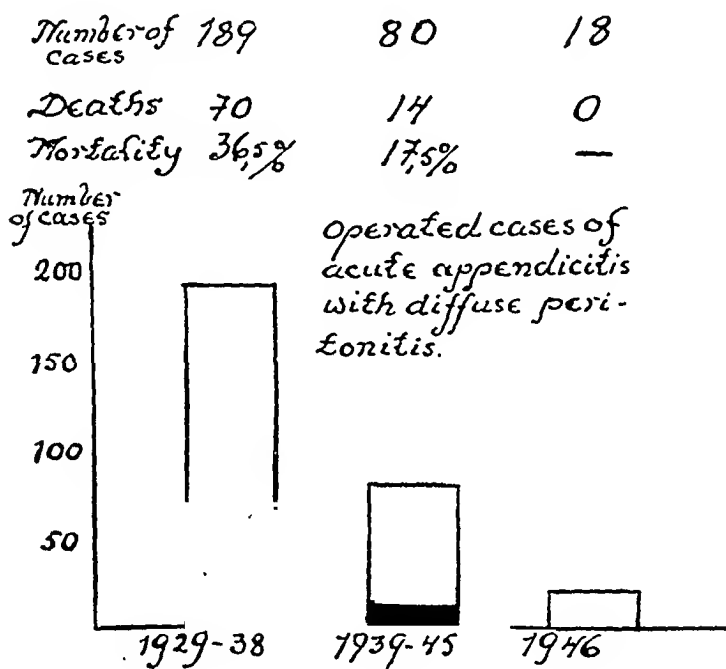
One cannot expect to obtain better results with dextran than with blood and plasma. In combatting the primary circulatory disturbances we have obtained just as good results. Dextran has no incidental effects and has the advantages besides of keeping for ever and of always being ready to hand.

In table 7 the cases are grouped together according to the changed treatment. During the years 1929—38 the death-rate was 36.5 %. The following period the mortality has decreased to 17.5 %, using serum- and chemo-therapy and a moderate fluid treatment. The last year there was no death and the treatment with fluid was much more intensive than before. Some cases also have

been treated with penicillin. The value of penicillin cannot, however, in these small statistics be analysed.

When taking into account also the cases operated upon over the first 9 months of 1947, 2 fatalities had to be observed among a total amount of 28 patients.

Table 7.



In 1946 for the first time in the annals of our hospital, there was no fatal issue to record in all the appendical peritonites treated. In some of the yearly reports for 1946 from other Swedish hospitals, identical favorable results could be stated.

### Summary.

The guiding principles in the treatment of appendical peritonitis can be summed up as follows:

1. Adequate shock treatment and prophylaxis.
2. An early and careful operation using preferably spinal anesthesia and sulfonamide locally. The abdomen closed. Drainage of the abdomen is ineffective, eventually harmful.

3. The most important point is the healing of the peripheral circulatory disturbances thus avoiding hydremia. The restoration of the intestinal movements runs parallel with this. Treat at first with large doses of dextran, blood or plasma. Supply eventually sodium chloride. Prostigmin and enema are not used. On the other hand repeated doses of morphia.

4. Septicaemia does not occur. If the source of infection is removed and the shock overcome the organism even conquers a bad infection in the peritoneum. Chemo-therapy with sulfonamides and penicillin possess perhaps a certain value.

5. With vomiting and meteorism discharge with gastric suction and oxygen inhalation. Avoid dehydration, hypochloremia and acidosis.

6. Early movements and exercise.

7. With ileus, conservative treatment with opium according to BACKER-GRONDAHL before operating.

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(Chief: Professor JOHN HELLSTRÖM, M. D.)

## **Obstruction of the Duodenum with Special Reference to Gallstone Perforations.**

By

JOHN HERTZ, M. D.

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### **Introductory.**

Although in the course of time a comparatively great number of cases have been published of duodenal obstruction, this disease presents so many peculiar features that casuistic reports must still be of interest.

### **Etiology and Pathogenesis.**

Duodenal obstruction may vary greatly in its etiology. The stenoses may be caused by congenital as well as acquired intra- or extra-duodenal diseases. They may further be divided into suprapapillary and infrapapillary stenoses according to their relation to the ampulla of Vater.

The congenital intraluminal stenosis which is due to an atresia and may be ascribed to an embryonal epithelial occlusion (TANDLER) has been thoroughly studied by FORSSNER; it is most frequently situated in the duodenum (DAVIES & POYNTER) where it has first been described by JAMES CALDER (1733), by BOERNERUS (1754) and by BOYD (1845). The intraluminal stenoses may further be caused by an intrauterine ulcer with obliteration of the lumen (DAHL IVERSEN). The congenital stenoses may also be due to disease outside the duodenum, in most cases an incomplete intestinal rotation. Further, an abnormal intestinal mobility, f. inst. a common ileo-colic mesentery with a consequent disposi-

tion for a volvulus, the proximal end of which is most frequently situated at Treitz's ligament (DAHL IVERSEN, JANKER), may cause a compression at the duodeno-jejunal flexure. An abnormal fixation at the duodeno-jejunal flexure as a result of abnormalities at Treitz's ligament may likewise give rise to a stenosis (HELLSTRÖM, NORDENTOFT). Congenital internal herniae may play a part too. In addition to the causes already mentioned compression may be due to foetal peritonitis with formation of adhesions, pressure produced by congenital tumors or cysts, or by an annular pancreas. TANDLER denies the pathogenetic significance of the deficiency in the intestinal rotation and the foetal peritonitis, but on the other hand it seems well established in many cases. An intermediate form to the acquired obstructions is constituted by the arterio-mesenteric compression, the causal factor of which is to be found in the anatomical conditions at the origin of the superior mesenteric artery where it rides across the inferior horizontal part of the duodenum. Numerous other factors are, however, of significance in this connection, congenital, as f. inst. asthenic type, short mesentery, long ptotic transverse colon, right-sided nephroptosis, pronounced lordosis, or even the erect posture of man; and acquired factors, such as: lack of fat in the mesentery or poor tone of the abdominal wall, as in multiparae. By "arterio-mesenteric compression" is understood a compression produced by a pressure between the spinal column and the aorta on the one side and the root of the mesentery containing the superior mesenteric artery on the other side. It must be borne in mind that the duodenum is normally slightly compressed and narrowed under the root of the mesentery, and consequently a tendency to obstruction will result if the lumen is further diminished. This mechanism was first described by ROKITSANSKY (1842); a number of investigators (KOSTLIVY, MELCHIOR) have, however, denied its very existence and relegated it to history, because in certain cases the dilatation is seen to continue some distance on the jejunum, that is, beyond the duodeno-jejunal flexure — as is indeed no doubt true in certain cases — and because of the lack of some mechanical causative factor. On the other hand so many well established cases are on record of true arterio-mesenteric compression that this viewpoint can hardly be maintained; thus, at post-mortem examination, by which it may be difficult to make the diagnosis (v. HABERER) it has been possible to demonstrate a clear furrow in the duodenum (BLANC-PER-

DUCET), and in some cases the operations have revealed a sharp demarcation between the dilated and the non-dilated intestinal area (CAMPBELL, LIDSTRÖM, VILETTE). The great significance of the downward traction is stressed by a number of authors (ASCHOFF, HORSLEY, HURST, MILLER & GAGE, ROSENTHAL, WILKIE), who even consider this traction a *sine qua non* for the development of the condition; on the other hand, at least one case has been reported in which the dorsal position of the patient is considered the factor directly responsible for the appearance of the symptoms (LIDSTRÖM). This holds probably good also of the cases in which the condition has arisen following pneumonia, typhoid or other diseases in which debile or emaciated persons are confined to bed (BECK). LERICHE has mentioned aerophagy as a pathogenetic factor giving rise to a slow gastro-duodenal distension which suddenly may develop into an acute arterio-mesenteric compression. There is no doubt that other factors are of no slight importance, viz. nervous reflexes from the stomach and the duodenum with lack of coordination between the sympathetic and parasympathetic systems. Impulses from the peripheral splanchnic and vagus branches will give rise to a dilatation of the stomach and a contraction of the sphincteric muscles of the cardia and pylorus (HUNTER, ROYLE). An operation in which a chloroform or ether narcosis will further reduce the tone of the stomach may involve a stimulation of visceral or somatic sensitive nerves and start a dilatation of the stomach, which by pressure posteriorly on the mesenteric vessels may produce an arterio-mesenteric compression (DEVINE, DRAGSTEDT; DRAGSTEDT, MONTGOMERY, ELLIS & MATTHEWS, GILLESPIE). In this way quite a number of cases, but not all, may no doubt be explained. Thus, an acute dilatation of the stomach may also arise following operations on the limbs.

Among the acquired intraluminal causes of duodenal obstruction mention should, apart from tumors (HERZ, HART HANSEN), be made of gallstones which have perforated to the duodenum and subsequently impacted themselves either in the superior part of the duodenum or at the duodeno-jejunal flexure and produced a total or partial obstruction here. Apart from the natural way through the choledochus the calculi most frequently leave the bile ducts through perforations to the duodenum; next comes the colon, and finally other organs. This relative frequency of the perforations to the duodenum was suggested as early as in



Murchison's classical report from 1877, but the same will be learned from any statistical account dealing with these diseases (COURVOISIER & NAUNYN, GREGERSEN, JUDD & BURDEN, POUL MÖLLER; ROTH, SCHROEDER & SLOTH; WAKEFIELD, VICKERS & WALTERS). One of the cases reported in the literature (SCOFIELD) presents features of special interest, in that it was impossible to demonstrate any fistula, or any scar after a fistula, between the bile ducts and the duodenum, for which reasons the gallstones obturating the duodenal lumen must be presumed in this case to have passed through the choledochus. In other instances the peculiar feature is that the calculi were not in themselves large enough to obstruct the lumen; they caused, however, such an inflammatory hyperplasia of the pylorus as to obstruct the passage (HALE WHITE).

The acquired extraluminal stenoses may be due to an ulcer or gallstone which has given rise to periduodenal or pericholecystitic adhesions, which may make a kink upon the duodenum or compress it, as described by many authors (ALEX, BIRCHER, COTTE, DUVAL & GATELLIER, FLEINER, HOCHHAUS, KEHR, MÜLLER, OLLENDORFF, PAPIN, WEGELE, VILLARD, just to mention a few in whose reports pericholecystitic adhesions were responsible for the condition). The duodenum may likewise be compressed by a glandular tumor in the root of the mesentery, "Flexure lymphoma", due to a simple inflammatory process as in appendicitis (DUVAL & ROUX, LARDENNOIS, OKINCZYK, WANTOCH), to tuberculosis (JANKER, KOSTLIVY, PENICH, ROWLANDS, VILETTE, WANTOCH), or to tumors that have metastasized (EICHMEYER, PETRÉN). Retroperitoneal tumors, liver tumors or liver cysts may likewise produce a compression with consequent obstruction of the lumen.

In some cases it has been impossible to ascribe the condition to any particular cause, for which reason purely functional, kinetic neuromuscular disturbances of the duodenal mobility (BRATTSTRÖM, GILLESPIE, KOSTLIVY, NORDENTOFT, PETRÉN) have been held responsible. If an infrapapillary stenosis persists for any length of time the duodenum will be dilated and possibly become hypertrophic above the stenosis thus forming a megaduodenum.

### Case Reports.

The author has had the opportunity to observe 3 cases of duodenal stenosis, 2 of which are to be reported here.



Fig. 2. The megaduodenum and a large part of the stomach removed en bloc at the operation. (Author's observation).

*History and examination.* A 35-year-old man who has been operated upon for appendicitis 3 years previously but has not presented other dyspeptic symptoms, has now for 2 years suffered from slight gastric trouble manifesting itself by epigastric pain. He has for this reason been on a mild diet for some time, having avoided meat, bread made from coarse flour, and highly spiced foods. X-ray examination about 2 years ago is said to have shown a vigorous dilatation of the duodenal bulb the size of an orange. The pains are described as a smarting sensation which radiates from the epigastrium to the right side of the back; they are relieved somewhat by food, and the pains have several times disturbed his sleep; no acid eructation, nausea or vomiting; there is a slight constipation; there has never been melena. Weber tests for blood in the stools are claimed to have been negative all along.

June 1st, 1945, he is admitted in good general condition, weight 59.6 kg. The routine examination reveals nothing abnormal. Hemoglobin 90 %, R. B. C. 5 mill, sedimentation rate 4 mm/h, N. P. N. 33, serum protein 7.8 %, hematocrit 45 %, blood chloride 82 mmol/l, alkaline reserve 65, bicarbonate 27.5 mmol/l. X-ray examination of the stomach (Fig. 1) shows a large duodenum with a niche, the size of a brown bean, immediately proximal to the dilatation.

*Treatment.* Operation (the author). Incision in the midline from the ensiform process to the umbilicus. An intestinal conglomerate tumor the size of two fists, is found and the ulcer is felt on the minor curvature corresponding to the pylorus, embedded in massive adhesions. The greatly dilated duodenum, which is the size of a tennis ball, is isolated from the tumor. At the hepato-duodenal ligament the dilatation is narrowed, and here a gland, the size of a hazelnut is found, which is extirpated for microscopic examination. The remaining portion of the tumor is formed by the transverse part of the colon, which lies close to the posterior abdominal wall, the transverse colon being only abt. 5 cm wide. A resection is performed of the dilated portion of the duodenum and about one-half of the stomach (Fig. 2) and a termino-

lateral antecolic anastomosis is made; further an entero-entero-anastomosis is made below the transverse colon. Suture.

The postoperative course is rather troublesome. A high fever sets in with indications of pneumonia, and treatment with sulfathiazole and penicillin is instituted. Just as he has recovered from the lung complication a slight thrombophlebitis develops in the right leg, proximal to the place at which a permanent drop infusion was instituted. On account of the heparinization (with AP) he gets a violent intestinal hemorrhage, but pulls through after blood transfusion and administration of vitamin K. The thrombosis as well as the pneumonia yields to the combined sulfathiazole-penicillin treatment, and he is discharged well.

*Reexamination* 16 months after operation (Questions by Dr. Romanus). He is in fairly good health; he cannot take in very large quantities of food at a time as rumbling in the stomach will result, but the pain will subside in a couple of hours; he tolerates all food if only he does not eat too much at a time; his strength is constantly improving.

*Epicrisis.* A 35-year-old man who has never previously had any stomach trouble, develops dyspeptic symptoms in 3 months, with pain which is relieved somewhat by food, further he has a slight constipation. X-ray examination reveals a large megaduodenum with an ulcerous niche immediately proximal to the dilatation; he is operated upon with removal and sewing down of the megaduodenum, and a typical resection of the stomach with an antecolic gastro-enterostomy is performed, the transverse mesocolon being too narrow to permit the establishment of a posterior anastomosis. After a somewhat troublesome postoperative course he is discharged without presenting symptoms of anything abnormal.

*Comments.* It is not possible in the present case to make any definite statement with regard to the etiology of the dilatation of the duodenum. The very narrow mesocolon seems to suggest a congenital anomaly, but it was not possible at the operation to demonstrate pathologic features in the region of Treitz's ligament. The gland removed for microscopic examination was not in such a position as to be held responsible for an obstruction of the duodenum, besides which it was hardly large enough to make any compression at all. The ulcer itself was situated proximally to the dilatation and, consequently, could not be regarded as the direct cause of any obstruction of the lumen. The causative factor may be a combination of the very extensive massive periduodenal adhesions and a congenital anomaly of which the very narrow mesocolon may be taken as an expression.

In the present case a juxtapyloric ulcer was found proximally to the dilatation, and it would seem as if this ulcer rather than the dilatation should be held responsible for the pain; this

HERTZ: Obstruction of Duodenum.

Fig 1. X-ray picture of a large megaduodenum with an ulcer in the pylorus just before the dilatation.  
(Author's observation )

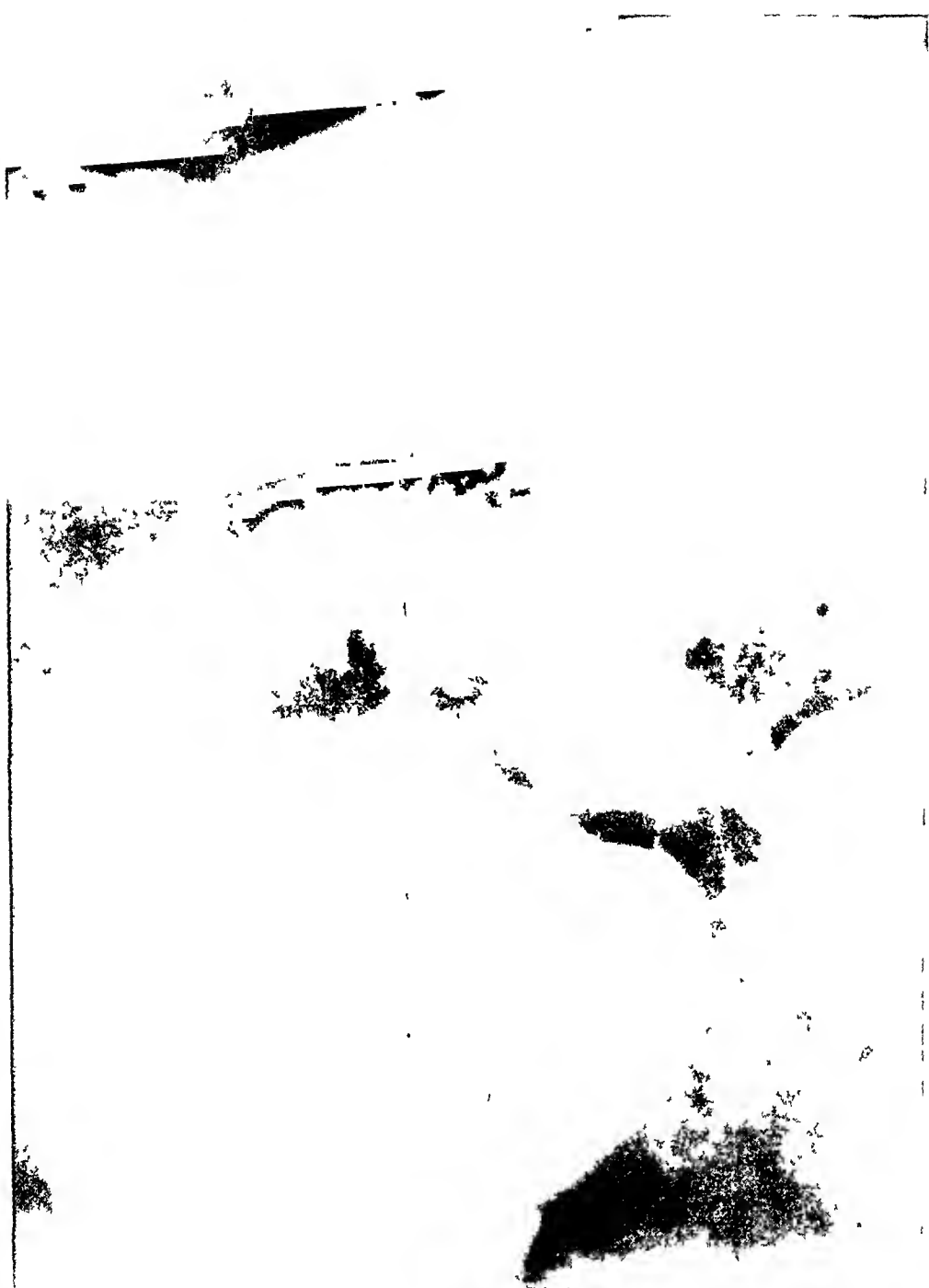




Fig. 3. X-ray picture of the superior part of the duodenum obstructed by a large gallstone.  
(Author's observation.)

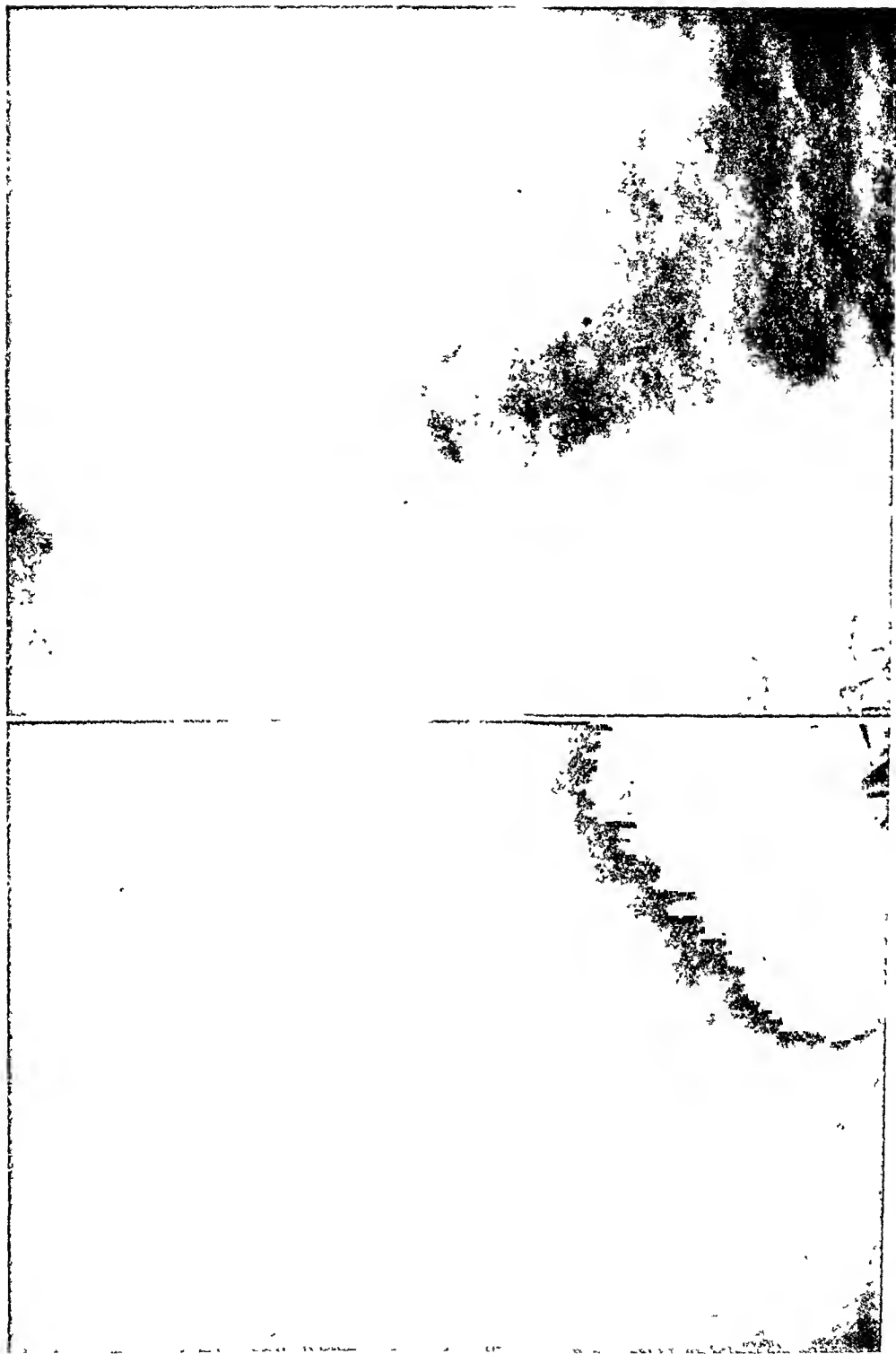


Fig. 5. X-ray picture of the superior part of the duodenum at the reexamination one year and a half after the operation.  
(Author's observation.)



combination of megaduodenum and ulcer is encountered too frequently in the literature to be a sheer coincidence (HURST; HURST, BRIGGS, ROWLANDS, JONES & RYLE, JANKER, MORLOCK & GRAY, WILKIE). It is actually to be assumed that the megaduodenum may act as a predisposing cause of ulcer (WILKIE) when other ulcer-producing factors are present (HURST); the predisposing factor must be the duodenal stasis.

*History and examination.* A 64-year-old man who has previously had a transient jaundice 4 times has for about 20 years suffered from slight gastric trouble consisting in epigastric pressure and acid eructations. The epigastric pains have aggravated the last 2 months, are now radiating to the right side and to the back. The last few weeks before admission he has only been able to eat liquid food, has suffered from acid eructations and, on one occasion, vomiting of a yellowish brown fluid. The feces as well as the urine has been of normal colour. Has for some time been coughing.

On admission, April 1st, 1945, to the medical department he was in an extremely poor condition, extremely emaciated, weight 49.4 kg, pale with a yellow tinge, seems slightly dehydrated. Stethoscopy shows fine rales at the base of the left lung; abdomen without tenderness, not distended; at the place of the gallbladder a resistance the size of a goose-egg is felt.

X-ray picture of the stomach (Fig. 3) shows strong peristaltics. The duodenal bulb is greatly deformed. With the patient in the dorsal posture an oval cavity, the size of a pear, lined with contrast, is seen to the right and above the bulb. This cavity probably is formed by the gallbladder, which has perforated to the bulb and adheres strongly hereto. Medially to the gallbladder, an air-filled passage, about the size of a knitting needle, is shown, probably corresponding to the choledochus. With the patient in the erect position, part of the hepatic ducts are also seen to be filled with air. On account of the stenosis the contrast passes into the intestines with the greatest difficulty.

*Treatment.* 1,300 cc bile-coloured fluid is aspirated from the stomach. A blood transfusion and a permanent intravenous drip infusion of sodium chloride and glucose alternately are given at once. April 9th. Hemoglobin 68 %. R. B. C. 4.5 mill. Blood pressure 115/80. N. P. N. 31 mg%; serum protein 7.5 %, hematocrit 32 %, blood chloride 87.5 mmol/l; alkaline reserve 74; bicarbonate 32 mmol. Liver function tests show no certain signs of damage to the liver parenchyma. Icterus index according to Meulengraecht 1 : 5. He is transferred to the surgical department for immediate operation, the cough has, however, aggravated, the temperature is rising and he brings up greenish muco-purulent sputum. The operation therefore has to be postponed and sulfathiazole is given as against pneumonia, as well as blood transfusions.

April 20th: the temperature has now improved considerably, and the operation being vitally indicated the risk of further postponement is considered too great. After a conference with an internist (Profes-



sor SVARTZ) the operation is performed (the author) as a transduodenal cholecystotomy. Oblique incision under the right curvature: hard conglomerate tumor is encountered, consisting of the gallbladder and the pyloric part of the stomach drawn up by the duodenum. An enormous calculus is felt in the conglomerate tumor and an attempt is first made to isolate the gallbladder; this is quite impossible. There is a possibility of freeing the gallbladder from the hepatic bed, but as this procedure would necessitate a cholecystectomy and probably also a resection of the pylorus, it is desisted from, it being considered too risky to expose the patient to a more extensive operation than strictly necessary. It is impossible to remove the stone through a gastrotomy as it does not present itself here and does not allow itself to be pressed into a suitable position. However, it presents itself fairly well posteriorly in the greatly dilated descending part of the duodenum. The stone is easily brought forward through a longitudinal incision in the duodenum, together with four stones the size of a hazelnut each. By palpating through the duodenum it is felt that the whole floor of the gallbladder is widely open into the duodenum, presenting itself only as a small diverticulum. The duodenotomy is closed with two rows of continuous catgut sutures and a row of interrupted sutures of silk; the last row of sutures also comprises the serosa of the stomach which lies close to the duodenum and affords an excellent cover. Two cigarette drains and three small drains are applied. Sulfathiazole in the abdomen, suture. The enormous stone,  $8 \times 4\frac{1}{2}$  cm, weight 54 grams (Fig. 4) consists mainly of cholesterol.

Immediately after the operation: 400 cc blood and a permanent drip infusion.

The postoperative course is rather troublesome; a painful hiccough persists for several days and can only in part be suppressed by atropine. When he is to get out of bed the pneumonia relapses, later followed by a third attack when, in addition, a pleurisy sets in. The lung complication is checked with penicillin. At discharge for convalescence he is well. The wound has healed.

*Reexamination* 15 months after the operation (the author). Owing to heart disease he is in rather poor health, but he presents no abdominal symptoms. He has gained weight and the scar is sufficient. Sedimentation rate 6 mm/h. X-ray examination (Frederiksberg Hospital, Copenhagen) shows a diverticulum from the posterior wall of the bulb; the shadow varies somewhat in size, from a pea to a hazelnut; it presents a clear air bubble in the top; the duodenum is well filled. The picture must be interpreted as contrast settling under the roof of the stump of the gallbladder left by the operation (Fig. 5).

Died August 28th, 1946 (Frederiksberg Hospital) from heart failure, without abdominal symptoms.

*Epicrisis.* A 65-year-old man who has previously presented icterus a couple of times, falls ill with gastric pain, eructation, vomiting on one occasion, and is in great haste sent into hospital in an extremely poor condition. X-ray examination of the stomach reveals a process with a cholecysto-duodenal perforation, probably a calculus which is

being delivered from the gallbladder into the bulb. After treatment with sulfathiazole for some days on account of an onsetting pneumonia he is operated upon, and a total obstruction of the duodenum is found depending on an enormous gallstone which has perforated into the duodenum. This stone, together with four smaller ones, is removed through a transduodenal duodenotomy. After a somewhat troublesome postoperative course he is discharged well.<sup>1</sup>

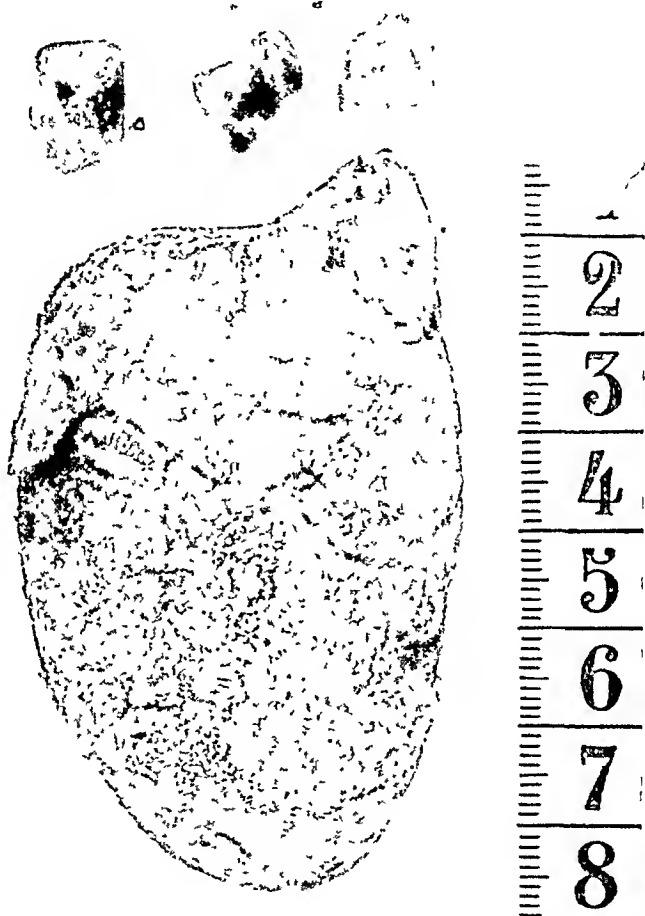


Fig. 4. The gall-stones removed at the operation. (Author's observation.)

*Comments.* The cause of the obstruction is in the present case fully elicited as being due to the very large gallstone which has perforated into the duodenum where it has obstructed the lumen

<sup>1</sup> The third case, which was operated by LENDORF, has been published in details by NORDENTOTT. This case, in which the patient was a 25-year-old man with a pronounced megaduodenum, presented a long taut Treitz's ligament which was divided although it was claimed not to be solely responsible for the obstruction; further, there were numerous periduodenal adhesions which were taken to be the most probable causative factor.

completely. The passage is reestablished by the operation, in which the stone is removed. In view of the poor condition of the patient a cholecystectomy could not be performed.

Only few cases of gallstones as the direct cause of obstruction of the duodenum are reported in the literature, and the author has therefore deemed it appropriate briefly to recapitulate the cases which he has succeeded in tracing in the available literature.

*Cases in which diagnosis was made at autopsy.*

Author	Sex	Age	Symptoms	Findings	Comments
CHOMEL (1710)	F	80	Very slight symptoms	22 gallstones in a diverticulum in the duodenum	Died from apoplexy
HARLEY (1857)	M	87		A gallstone (Weight 450 grams) in a cul-de-sac in the duodenum	
HOCHHAUS (1891)	M	67	Sudden onset; vomiting, constipation, loss of appetite. At the place of the gallbladder a palpable tumor which disappears later on	Duodenum obstructed by a large gallstone (size 3.8×4 cm) at the duodeno-jejunal flexure.	
ATKINSON (1895)	F	62	Pain, vomiting	A gallstone (size 1½×1 inch) impacted at the duodeno-jejunal flexure	
GARIN (1897)	F	82	Pain, vomiting, constipation, extreme emaciation	The superior part of the duodenum obstructed by a large gallstone (Weight 14 grams)	
LABADIE, LA-GRAVE & MA-DELEINE (1898)	F	72	Many years' history of gallbladder disease, vomiting, loss of weight	Duodenum obstructed by a large gallstone	
DUFOUR (1901)	F	50	Extreme emaciation, diarrhoea; bronzed skin, resembling Addison's disease	Duodenum obstructed by a large gallstone (Size 21×34 mm)	No particular symptoms of obstruction
WAKEFIELD, VICKERS & WALTERS (1939) (Mayo-clinic)	F	31	Definite symptoms of intestinal obstruction	Duodenum obstructed by a gallstone	

*Cases in which the patient was cured without operation.*

Author	Sex	Age	Symptoms	Result
FIEDLER (1880)	F	66	Similar attacks one year previously. Anamnesis of 1 year with epigastric pain. Now collapse with severe pain and vomiting of hemorrhagic masses. 8 days later repetition hereof. A tumor can be felt at the place of the gallbladder; next day the tumor has disappeared.	A calculus, weight 12 grams, passes per anum 6 days later
"	F	34	Pain, extreme emaciation	A big calculus passes per anum 4 months later
SCHÜLE (1894)	F	35	Anamnesis of 3 years with vomiting, loss of weight and moderate pain in the right hypochondrium Now suddenly pain and collapse resembling a perforation, but no peritonitis sets in; bile-containing vomit. The symptoms subside.	A calculus, 2.7 × 9 cm passes per anum 5 days later
WILKINSON (1897)	F	63	Vomiting, sharp pain. Distention of the abdomen later. The symptoms subside	A calculus the size of a pigeon's egg passes 11 weeks later
DUCHESNE (D'OREEC) (1897)	F	88	Vomiting, sharp pains, palpable tumor. The symptoms subside.	A calculus the size of a pigeon's egg passes 4 days later
MINTZ (1928)	F	61	2 phases: 1) Cramp-like abdominal pains, vomiting, fever. 2) Hemorrhagic profuse vomiting, stop in the evacuation and flatus. The symptoms subside	A calculus passes per anum 10 days later

In some few cases of gallstone it has been possible clinically to map out the very cholecysto-duodenal passage (FIEDLER, MAYO ROBSON, MINTZ, SCHÜLE), although it must be presumed that in many cases this process does not give any symptoms at all (MONDOR, MAYO ROBSON); this is not the rule, however, and cannot be (MONDOR). When symptoms have been present they have taken the form of intensive stabbing pain, thus resembling, initially, a perforation. Fever and muscular rigidity will set in and a re-

Author	Sex	Age	Symptoms	Finding	Operation	Result	Comments
TAYLOR (1884)	F	66	Very slight symptoms during a rather long time. Pain, vomiting	The lowest $\frac{1}{3}$ of the duodenum obstructed by a large gallstone measuring $1 \times 1\frac{1}{2}$ inches	The calculus was removed	Death on the 5th p. o. day	Two years previously similar attacks. A stone the size of a nut passed per anum.
BOUVERET (1896)	M	46	Sudden sharp pains, loss of weight	Duodenum obstructed by a gallstone which protrudes partly through a fistula immediately below the pylorus.	The calculus was removed through the stomach	Death from hemorrhage on the 3rd p. o. day	
HERZ (1896). Operation by v. NICKULICZ	F	44	Pain and vomiting during a year; loss of weight (18 kg)	Duodenum obstructed by a gallstone	Gastro-enterostomy	Recovery	
WEGELE (1898) Operation by SCHEDEL	M	48	Anamnesis of 6 years. Epigastric pressure, constipation, loss of weight	Duodenum obstructed by a large gallstone; 4 smaller stones besides	Cholecystectomy + resection of the pylorus	Death	
MONPROFIT (1897)	F	58	Attacks previously. Vomiting and jaundice, loss of weight, palpable tumor	Large node corresponding to the duodenum. "inoperable".	Nono	Death	The autopsy revealed a large gallstone which obstructed the duodenum immediately below the pylorus
FLEISCHHAUER (1899)	F	37	During a year pain, vomiting, loss of weight. Palpable tumor	The pylorus obstructed by a large gallstone.	The calculus was removed through the stomach. The pylorus was extirpated. From the gallbladder 45 smaller calculi were removed	Recovery	
PILCHER (1902)	F	60		The duodeno-jejunal flexure obstructed by a gallstone, diameter 1 inch.	The stone was removed	Recovery	

TUPPER (1903)	F	31	Pains during 6 years; numerous attacks. Vomiting, loss of weight, palpable tumor	Duodenum obstructed by numerous faceted gallstones	18 calculi were removed through a gastrotomy, after which the others passed	Recovery	
GOLLINGER (1903) Operation by KRASKE	F	43	Loss of weight; once vomiting, pain. Palpable tumor	Duodenum obstructed by a large gallstone	The calculus was removed through a duodenotomy	Recovery	
FRIEDMANN (1908) Operation by BLAKE	F	35	Attack 6 years previously. Pain, vomiting, loss of weight. Palpable tumor. <i>Cramps in the legs and the fingers</i>	One big stone and some smaller ones impacted in a cul-de-sac obstructing the duodenum	Cholecystectomy + gastro-enterostomy + duodenorrhaphy	Recovery	
MAXO ROBSON (1909)	M	76	Pain in the right hypochondrium, vomiting	Duodenum obstructed by a big gallstone, size $3 \times 3\frac{1}{2}$ cm	The calculus was removed through the stomach	Recovery	There was a fistula to the colon.
THOMPSON (1912)	M	65	Anamnesis of 9 months. Pain, vomiting, loss of weight	Large node corresponding to the duodenum	The node jumps into the stomach and proves to be a gallstone, size $4.5 \times 2.6$ cm; the calculus was removed through the stomach	Recovery	
TUFFIER (1914)	F	51	Vomiting, loss of weight, pain	Duodenum obstructed by a gallstone	Gastro-enterostomy. 2' stage; Resection of pylorus + resection of the gallbladder, part of which is removed with a part of the duodenum	Recovery	
OKINCZYO (1921)	F	Not mentioned	Not mentioned	Duodenum obstructed by a large gallstone	Not mentioned	Not mentioned	

Author	Sex	Age	Symptoms	Finding	Operation	Result	Comments
BÉRARD (1921)	Not men- tioned	Not men- tioned	Not mentioned	Duodenum obstructed by a large gallstone	Gastro-enterostomy + removal of the stone	Not mentioned	{ Same meeting in the Soc. de Chir. de Paris
SANTY (1921)	Not men- tioned	Not men- tioned	Not mentioned	Duodenum obstructed by a large gallstone	Gastro-enterostomy + removal of the stone	Not mentioned	
GOUILLOUD (1921)	F	62	Vomiting, pain, loss of weight, palpable tumor	Pylorus obstructed by a large gallstone (Size 29×17 mm)	Gastroenterostomy, + duodenotomy with removal of the stone	Recovery	{ A large stone passes per anum one month later The diagnosis made by X-ray examination, but the patient first refused operation, but agreed at a new crisis, No fistula or scar between the gallbladder and the duodenum
VINOT (1922)	F	40	Vomiting, loss of weight		Gastroenterostomy	Recovery	
BROCO, BRODIN & ANNÉ (1929)	F	50	Crisis one year previously Vomiting, loss of weight	At operation a stone was found in the jejunum	The calculus was removed	Death	
SCOTFIELD (1930)	F	60	Bile-anamnesis with jaundice. Pain, loss of weight. No symptoms of obstruction. NPN 33.6 mg. Blood urea 14	Duodenum obstructed by 10 gallstones	Duodenotomy by which 10 gallstones were removed + cholecystotomy with removal of one gallstone + choledochotomy with removal of 2	Recovery	
MITCHELL (Cited after MONDOR 1930)	Not men- tioned	Not men- tioned		Note corresponding to the pylorus, taken to be a cancer	Gastroenterostomy	Death few days later	The autopsy revealed 2 gallstones which obstructed the pylorus and the duodenum, one of these in a fistula

CRANE (1931)	M	80	Acute onset with pain. Vomiting, loss of weight. Comparatively unaffected; walks into the ward after having gone 60 miles by motor car	Duodenum obstructed by a gallstone at the duodeno-jejunal flexure.	The stone was removed	Death on the 4th p. o. day.	between the gall-bladder and the duodenum, the other in the gall-bladder The diagnosis was made at the X-ray examination
WAUGH (1937) (Mayo-clinic)	M	72	Anamnesis of one year. Sharp pain, vomiting, loss of weight (15 kg), jaundice on one occasion	Duodenum obstructed by 2 gallstones	Pylorectomy + Cholecystostomy by which 65 eatenuli were removed	Recovery	At the X-ray examination the disease was taken to be a duodenal ulcer: no function of the gall-bladder
WAKFIELD, VICKERS & WALTERS (1939) (Mayo-clinic)	F	44	Recurring symptoms of intestinal obstruction	Duodenum obstructed by a gallstone	Not mentioned	Recovery	
	M	49	Definite symptoms of intestinal obstruction	Duodenum obstructed by a gallstone	Not mentioned	Recovery	
ANDERSON, Br. (1942)	F	65	Anamnesis of 10 years. Vomiting, loss of weight	Duodenum obstructed by a plum-sized gallstone	Duodenotomy with removal of the stone	Recovery	At the X-ray examination the diagnosis was taken to be a polypous tumor
SHEINFELD & MACKLER (1943)	F	62	Attacks previously. Vomiting. Urea nitrogen 12.5 mg%	Duodenum obstructed just below the pylorus by a large gallstone, size $6\frac{1}{2} \times 4 \times 4$ cm	The calculus was removed through the stomach. Cholecystectomy	Death on the same day	The X-ray picture revealed a large stone in the upper right quadrant
THE AUTHOR (1945)	M	64	Jaundice several times previously. Now pain, cruetation, once vomiting; extreme emaciation	Duodenum obstructed by a large gallstone, size $8 \times 4\frac{1}{2}$ cm, weight 54 grams	Duodenotomy with removal of the calculus	Recovery	The diagnosis was made at the X-ray examination



stones may be felt at the place of the gallbladder, while the symptoms of a diffuse peritonitis will fail to appear. Hemorrhage will set in in the form of melena, or it may bleed into the stomach with subsequent sanguineous vomit. The stone itself may pass into the stomach and be vomited, as already mentioned by JEAN LOUÏ PÉRI in 1743, or it may be aspirated from the stomach (GUTHRIE), or it may pass per anum, as in the cases reported by FRIEDRICH MAYER and SPOHN.

### Summary.

After a brief summary of the etiology and pathogenesis of the duodenal obstruction 2 cases are reported; in one of these, the case of a man, 65 years old, the obstruction is due to a very large gallstone which from the gallbladder has perforated into the duodenum and impacted there; in the second case, a typical megaduodenum in a 35-year-old man, the genesis is not fully cleared up, but much is in favor of the view that the real causative factor is a congenital anomaly. After a recapitulation of the cases reported in the literature of gallstones as the causative factor of obstruction of the lumen of the duodenum, a brief account is given of the relation between megaduodenum and ulcer.

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## A Case of Abrikossoff's Tumor or so-called Myeloblastic Myoma.

By

TORSTEN BJÖRKROTH.

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The author has for somewhat over a year had the management of a case of so-called Abrikossoff's tumor, or as it also, though perhaps rather inadequately is termed, myeloblastic myoma, localized to the floor of the mouth. As this is a quite uncommon and as far as I can see a probably not well known condition, which in addition offers interesting problems relative to its genesis and histopathology, I have considered a report of the case worthy of interest.

The case is that of a man aged 49 (S. L. N. 55/46), who in January 1946 sought my advice for a swelling in the floor of the mouth. He had observed it for about 6 months. It had grown fairly slowly and had not caused him other inconvenience than that his mouth now began to feel "thick". Under the right side of the tongue there was a walnut sized, rounded, soft protrusion of the floor of the mouth. He also showed a rather diffuse swelling beneath the brim of the right inferior mandibula. Bimanual palpation gave an impression of a pseudo-fluctuation. With the tentative diagnosis of a retention cyst of the sublingual gland an incision of the oral mucosa was done. The flow of saliva expected was however not obtained. Instead a peculiar lobulated, well limited, soft tumor mass oozed forth. The lobulated nodes were rather angular and about the size of a navy bean or smaller. Additional tumor masses were easily removed by blunt dissection with the finger. The colour was brownish red and the entire mass was both in regards to consistence and colour reminiscent of fetal liver tissue.

Pathological-anatomical diagnosis: "The tumor examined is poorly vascularized and cells and cellular contents have partially disintegrated, leaving large vacuoles. The remaining cells are often large, here and there forming connecting groups without distinct cell borders. The cytoplasm shows a marked fine granulation and the small granulae are stained faint pink with eosin. No definite metachromism is de-

monstrated on methyl violet or thionin stains. Toluidine blue according to Sylwén's method is negative, showing that the cytoplasm does not contain esters of sulphuric acid. The nuclei are generally equal in size, compact, without polymorphism or hyperchromasia. A number of the nuclei are of a vesicular type with fairly large nucleoles. Unstained sections photographed by B. THORELL according to Caspersson's method with a wavelength of 2,600 Å shows nucleotides in the nucleole and cell membranes but very little in the cytoplasm. (Fig. 1.) The absence of nucleotides in the cytoplasm suggests that the cytoplasm protein formation — contrasting to immature cells — does not take place to any noteworthy extent. The morphologic pictures are in agreement with those benign tumor-like changes, which in the literature are termed Abrikossoff's tumors or myeloblastic myomas. WILTON."

The patient was discharged after one week. The same year, in December, he returned with a new local relapse. The tumor was this time still larger with a marked, diffuse swelling beneath the lower jaw-bone. A new operation was done with the incision placed on the outside of the lower jaw-bone into the sublingual cavity. As before it was fairly easy to remove the tumor masses with the finger. The masses were of the same appearance as previously with inter alia the peculiar lobulation resembling a bunch of grapes. A rather profuse bleeding ensued which forced me to interrupt further attempts to extricate the tumor-masses. By then I had dug far up into the tongue. Most of the tumor masses seemed to be removed, but my impression was, that some still remained. Evidently the entire floor of the mouth and the tongue were invaded by the tumor tissue.

The incision was sutured and healed at primary intention, although with a rather large hematoma of short duration in the mouth. The laboratory findings afforded nothing of interest. Thus, the blood status was normal, the Wassermann test negative and the sedimentation rate 6 mm. per hour. A section was again sent for histological examination. The report was the same as previously.

In view of the fact that the tumor probably was not completely removed the Jubilee Clinic in Gothenburg was consulted as to the advisability of a radiological follow-up treatment. This was advised and the patient received a vigorous post-operative irradiation. I have now seen him a couple of times and he has not yet shown signs of relapse. It is, however, probably too early to give a final statement.

As mentioned above, the present case is an uncommon kind of tumor. In 1926 the Russian pathologist ABRIKOSSOFF described 5 cases of tumor growth localized in 3 cases to the tongue, in 1 case to the lips and in 1 case to the muscles of the calf — all having a peculiar but identical histological structure. They consisted of one single type of cells, large, finely granulated elements with a faintly basophil cytoplasm, placed in syncytial groups in a stroma of connective tissue. The cells were small without polymorphism and with no or negligible mitosis. The structures were

generally non-capsulated. ABRIKOSOFF believed at first that these were true tumors made up of embryonal striated muscle cells, the so-called myoblasts.

Other authors later agreed with ABRIKOSOFF's theories, among others KLINGE, who, however, also described some cases where the tumors were subcutaneous and thus not directly connected with striated muscle cells. He considered their origin to be dysontogenetically based. In 1931 ABRIKOSOFF had collected a larger series with a wider localization. He still stuck to his first theory relative to their histological genesis, as far as those tumors connected with striated muscle were concerned, but shared KLINGE's opinion of dysontogenesis in regard to those localized elsewhere. He had placed them into four groups according to various deviations in their histological structure, which I will not enter upon, that question being a specific pathological-anatomical problem. Although later the majority of authors agreed with ABRIKOSOFF's opinion in regards to the genesis, some scientists in this question have another view, considering that they are not true tumors in the usual sense of the term. Thus, ROFFO thinks, that we here have a degenerative disintegration of the striate musculature. Others have compared these tumors with sarcoma-like formations with pronounced cellular polymorphism and termed them malignant myoblastomas or merely myoblastomas.

A worker here in Sweden, especially interested in these "tumors" is NILS RINGERTZ. He has given a detailed description of their histological and pathological structure, their surmised genesis, their localization etc. etc. RINGERTZ argues, on good grounds, that they are not true tumors and that they still less are derived from the myoblasts. He stresses, inter alia, that it is contrary to all pathological experience for a growth, originating from such early embryonal cellular elements as myoblasts, to show such a morphologically benign cellular picture and histologically to be so non-malignant, as these ABRIKOSOFF's tumors are. He considers that it is not at all proven that their genesis has any association with striated muscle cells.

The histological pictures obtained — this relative to the lingual tumors only — which has been the reason of connecting their genesis with the striated musculature, are, according to RINGERTZ, simply remnants of muscle fibers, atrophied because of the pressure of the tumor and often cut off square or at an angle, thus simulating granulating cellular elements.

RINGERTZ does not either consider that ROFFO's theory, that we here are concerned with a purely degenerative phenomenon, holds true. It is possible, he argues, that this is what the Germans very aptly call a "Speicherungstumor"; in translation this might perhaps be termed "storage" or "deposit" tumors. There might possibly be the question of an albumin "Speicherung" in the connective tissue or in the reticulo-endothelial cellular elements, due to some metabolic disturbance.

The tumors — clinically regarded they must be considered as such — are, as was mentioned above, unusual. RINGERTZ in 1942 after a careful review of the literature, weeding out a number of cases which he considered uncertain, showed, that there in that time existed 77 known and proved cases. He himself had succeeded in collecting 11 cases, pathological-anatomical specimens, 4 of which, however, were a loan from FRENCKNER.

The tumors usually arise in the oral cavity, mainly in the tongue, about 50 % of the cases, and also in the lips and in larynx and the bronchi (FRENCKNERS 4 cases). They have also been observed in subcutis in various localizations of the body, in mammae (4 cases), in the muscles of the extremities, thus in the muscles of the calf (2 cases), in the abdominal wall (1 case) and in the vagina (1 case).

The lingual tumors have generally been localized under the mucosa, usually in the base of the tongue, sometimes in the side of the tongue and occasionally in the tip. The size of the tumors has varied from the size of a small pea to that of a hazel nut. They are described as rounded, slightly protuberant growths and are usually covered with smooth mucosa. A few cases with a slight ulceration have been observed. The consistence is rather hard. They are well defined and show a light grayish-brown to yellow cut surface. The labial tumors have been about the size of a pea, which also is the size of those, found in the trachea and bronchi. The 2 tumors localized to the calf were appreciably larger, being the size of a hen's and a goose-egg respectively. One of the mammary tumors was 10 cm in diameter, the other considerably smaller.

Only 2 cases are previously described with a localization to the bottom of the mouth, both by ABRIKOSOFF. They seem on the whole to be in accordance with the present case, and are thus divergent, both in size and in macroscopical structure from the description given above. They were the size of an egg and a fist



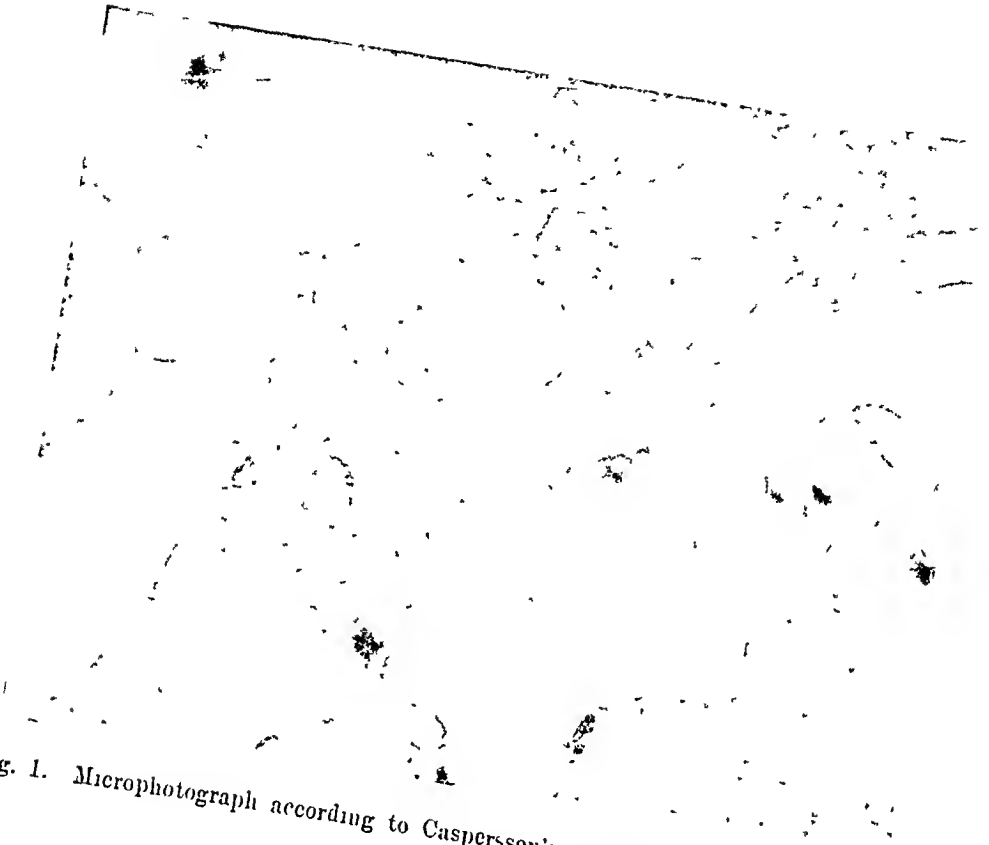


Fig. 1. Microphotograph according to Caspersson's method, wavelength 2,600 Å.

BJÖRKROTH: Abrikossoff's Tumor.



respectively, and markedly lobulated although well limited. FRÄNSDORFF also has described a case with a lobulated appearance, localized to the posterior pharynx wall and also larger in size. The colour of the ABRIKOSOFF's oral tumor is, however, more like that of the common type — in the present case the colour was a dark brown — and in contrast to my case, they also seem to have been easy to remove, as there was no involvement of the muscle bundles. They do not seem to have recidivated. Histologically these lobulated types differ somewhat from other tumors, displaying considerably larger cells. For the rest the structure is the same.

The tumors usually have a slow growth. Lingual tumors are reported to have been observed for three or four years but there are also some cases with a much faster growth. They are benign and do not metastasize. Two cases of local recurrence are described, however, but they do not seem to have been completely removed from the beginning. This was the fact in my case. It is complicated by the tumor having invaded the muscle bundles of the tongue, thus being clinically malignant because of its localization to an organ which can hardly be removed, even though each node is clearly defined from the surrounding tissue.

The sex distribution has been equal and the tumor has been observed at all ages. In infants it has arisen in the oral cavity in the form of congenital epulides and has attained a considerable size, even causing difficulty of respiration.

The treatment does not offer much of interest, especially in those cases, where a simple extirpation in free tissue easily is done. It now remains to be seen to what extent the radiological therapy tried in the present case is efficacious. The observation time is as yet too short to allow any conclusions. Theoretically, the irradiation therapy ought to have a favorable effect if the tumor in agreement with ABRIKOSOFF's opinion has originated from young, immature cells, while on the other hand clearly degenerative phenomena would hardly be amendable to influence.

### Summary.

A rare case of so-called ABRIKOSOFF's tumor or myoblastic myoma in a man of 49, localized to the floor of the mouth, is reported. The question of the genesis of these tumors is interesting and opinions thereon differ. ABRIKOSOFF considered that these

tumors originate from immature cells, myoblasts. RINGERTZ believes that there is a disturbance of metabolism with an accumulation of albumin in the connective tissue or the reticulo-endothelial cellular elements, and that they thus are not tumors in the true sense of the word. They are non-malignant, are usually slow in growth and do not recur if they are radically extirpated. The most common site is the tongue, but they have also been observed in the lips, the larynx, the bronchi and in subcutis. The size is usually that of a hazel nut. The tumors of the floor of the mouth of which only two have been previously observed, are a good deal larger and are also lobulated.

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## Un cas de péritonite scarlatineuse «primitive».

Par

HANS ÖHRLING.

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Les nombreuses complications de la scarlatine sont, à tout prendre, bien connues et ont été décrites assez fréquemment dans la littérature. Parmi celles qu'on rencontre moins souvent figure la péritonite scarlatineuse, comme on l'a appelée, qui en dépit de sa rareté offre un certain intérêt, d'abord sous l'angle du diagnostic différentiel, ensuite à d'autres points de vue encore.

L'expression de péritonite «primitive» a été mise en cours par TAVEL et LANZ en 1893, bien qu'on l'eût déjà rencontrée antérieurement. Elle implique, selon une définition ultérieure de GROTTI (9) une infection du péritoine ne s'accompagnant d'aucune autre lésion anatomique dans l'organisme, «and in which the inflammatory irritant acts directly upon the peritoneum, without producing any decided alteration whatsoever in other organs in its path».

Une péritonite qui survient en relation plus ou moins étroite avec une scarlatine, et où l'on ne trouve, dans l'abdomen, aucune altération anatomo-pathologique pouvant être considérée comme sa cause, a reçu le nom de péritonite scarlatineuse primitive. Dans la plupart des cas on a admis qu'elle était due à une propagation de l'agent infectieux par voie sanguine ou par voie lymphatique. Par conséquent il aurait peut-être fallu, avec SCHILLING (17) et d'autres auteurs, l'appeler péritonite secondaire. Cependant il vaut mieux, semble-t-il, réserver ce qualificatif aux cas où l'on a vraiment pu mettre en évidence un foyer pathologique primitif à l'intérieur de la cavité abdominale.

Les expressions de «cryptogénétique» ou d'«idiopathique» rencontrées aussi ne sont guère préférables pour caractériser ces péritonites, surtout que dans des circonstances plus favorables un certain nombre de cas auraient pu être étiquetés d'un diagnostic autre et plus exact.

Voici la relation succincte d'une de ces péritonites *primitives*, dont on a eu des raisons de soupçonner l'origine scarlatineuse.

Une veuve de 45 ans, Mme A. R., fut envoyée dans le Service, venant d'un hôpital de maladies épidémiques où elle avait été hospitalisée un ou deux jours auparavant pour scarlatine présumée. A l'admission elle était très fortement éprouvée et avait de la peine à expliquer les troubles qu'elle ressentait. Elle avait eu de la fièvre pendant 15 jours, autour de 38°—38.5°. Au début elle avait présenté une éruption sur le corps, et elle avait souffert pendant tout le temps de difficultés à la déglutition. Diarrhées aqueuses les deux premiers jours, mais sans douleurs de ventre. Une semaine avant son entrée dans notre Service elle avait de nouveau eu des diarrhées très liquides, jaunâtres, ainsi que de la desquamation, particulièrement marquée au pli des coudes. La veille de son arrivée ici, douleurs très fortes et persistantes au milieu de l'abdomen, qui était tendu. Ni selles ni émissions de gaz. N'avait jamais souffert du ventre antérieurement.

*Status*: État général très fortement touché. Malade pâle et éprouvée. «Facies hippocratique». Température de 38°. Vitesse de sédimentation de 108. Pouls petit, faible et rapide. Desquamation aux deux avant-bras exclusivement. Cavité buccale et gorge: amygdales rouges et tuméfiées. Pas d'amas caséux. Cœur et poumons: r. d. p. Abdomen: gonflé et tendu. Douleur intense de tout le ventre à la palpation, surtout du côté droit. Rien de palpable dans la profondeur. Examen recto-vaginal: bombement du Douglas.

L'intervention immédiate fut décidée. A cause de la légère prédominance de la sensibilité du côté droit elle consista en *Laparotomie + appendicectomie + drainage*. Narcotal + Protoxyde d'azote.

Incision de M. B. au lieu d'élection. Le péritoine est épaissi et dépoli. Il y a dans le ventre un abondant épanchement jaune d'or, très fluide, du pus ainsi que de simples mucosités, mais pas de débris alimentaires. Le grêle et le colon sont abondamment revêtus de fibrine. L'iléon est fort rouge, et le grêle gonflé d'oedème. Le mésentère est oedématié, avec de-ci, de-là, des sugillations sanguines, et il présente de nombreuses «glandes» de petit volume. L'ascendant et le cœcum sont sans particularités. L'appendice est épaissi, et les vaisseaux de sa séreuse sont injectés. On n'y voit aucune perforation mais on l'extirpe à la façon ordinaire. Après avoir prolongé l'incision on palpe la vésicule biliaire sans rien y trouver. L'utérus est grand, fibromateux, mais n'offre par ailleurs rien de spécial. Les annexes des deux côtés étaient considérablement grossies et d'un rouge intense. Il n'en sortait pas de pus à la pression.

Un drain est mis dans le Douglas, un autre dans l'étage supérieur de l'abdomen. Puis on suture la paroi. Examen de la pièce: La paroi de l'appendice est épaissie macroscopiquement, mais l'organe donne l'impression d'avoir été infecté secondairement. On l'envoie à l'examen microscopique. De même, l'exsudat péritonéal est envoyé au laboratoire aux fins de cultures. Réponse: Streptocoques hémolytiques B.

Malgré les analeptiques, l'administration de liquides et de pénicilline,

la malade décéda de bonne heure le lendemain matin, sous le tableau d'une insuffisance circulatoire.

L'autopsie montra des altérations septiques dans un bon nombre d'organes, ainsi que la péritonite dont il a été question et une amygdalite, mais par ailleurs rien qui pût servir de fil conducteur pour retrouver le point de départ de l'inflammation.

*Examen microscopique:*

L'*appendice* a une muqueuse bien conservée sans lésions inflammatoires. La sous-muqueuse est un peu épaissie mais ne présente point d'infiltrations cellulaires inflammatoires. En revanche, on voit à la surface externe de l'organe un dépôt fibrino-purulent, ainsi qu'une infiltration leucocytaire dans la sous-séreuse. L'image concorde avec celle d'une appendicite secondaire. (C. G. AHLSTRÖM.)

Les fragments de *colon* et d'*iléon* envoyés à l'examen montrent des altérations inflammatoires à l'intérieur de la muqueuse. Toute la paroi intestinale est le siège d'un oedème, et ça et là on trouve une assez grande abondance de leucocytes polynucléaires dans la séreuse et la couche externe de la musculaire. En outre, on voit par places des dépôts fibrineux sur la séreuse avec d'abondantes inclusions de cellules du pus. La *musculature du coeur* est farcie de pus et les fibres musculaires sont dissociées par l'oedème. On a donc l'image d'une grave *myocardite suppurée*. Le *foie* présente une dégénérescence graisseuse à gouttes volumineuses dans les cellules hépatiques, et de plus il est parsemé, de façon diffuse, de leucocytes polynucléaires. Dans les zones conjonctives périportales cette infiltration est un peu plus marquée. Les voies biliaires ne sont pas dilatées. Pas de signes de stase biliaire. La *rate* montre une pulpe riche en cellules. Sa structure est conservée. L'abondance des cellules, constituées par des leucocytes polynucléaires et des plasmacytes, parle pour une hypertrophie septique de la rate. Au niveau des *reins* on constate quelques petits foyers isolés dans la corticale. Ils montrent une inclusion de cellules inflammatoires, aussi bien de lymphocytes que de leucocytes. Par ailleurs il n'y a pas de modifications du tissu rénal. L'*ovaire* est normal, à part, de-ci, de-là, une irritation inflammatoire superficielle avec de l'hyperémie et une mince couche de fibrine parsemée de cellules du pus.

*Résumé (diagnostic anatomo-pathologique):*

Péritonite purulente, sans point de déj art connu. Myocardite purulente et néphrite en foyers. Atteinte septique de la rate et du foie. (N. O. BERG.)

Ainsi donc, la confrontation des constatations cliniques avec les résultats obtenus par l'examen bactériologique et anatomo-pathologique parle fortement en faveur de l'idée qu'on a eu, ici, affaire à l'un de ces cas, bien rares, de péritonite scarlatineuse *primitive*, comme il est convenu de les appeler. Il s'y ajoute, à titre de corroboration, que peu de jours après l'admission de cette

patiente à l'hôpital un enfant y tomba malade de scarlatine typique. Deux autres enfants contractèrent une angine et furent examinés par le médecin spécialisé dans les maladies épidémiques, mais on ne put reconnaître de façon certaine l'existence d'une scarlatine chez eux.

La péritonite scarlatineuse peut survenir de diverses façons, ce que j'exposerai brièvement plus bas. Le nombre des cas de péritonite primitive publiés jusqu'ici ne dépassait pas 23, avant 1941. Le chiffre s'élève très considérablement si l'on y inclut ceux où l'on a rencontré un «foyer» ou un autre dans le ventre. BANNER-VOIGT, qui a examiné environ 2,000 cas de scarlatine a trouvé parmi eux 23 péritonites, dont seulement 4 étaient primitives. WEAVER (Chicago), sur 2,595 scarlatines n'a pas vu une seule péritonite (1913—1922). Un autre matériel, de 2,500 cas de scarlatina, examiné par l'Américain SOMERSET, n'offrait aucun exemple de péritonite. Sur 6,400 cas de scarlatine à Brême, dont une grande partie étaient épidémiques, on n'en a pas trouvé moins de 298 qui se compliquaient de pleurésie ou de péritonite. (STIMMER: 1938—1942) (19). Dix cas furent étudiés de plus près, ce qui permit de déceler un streptocoque hémolytique comme agent causal. Cependant le diagnostic de scarlatine ne fut pas établi de façon indubitable dans ces cas-là, pas plus que ne l'a été la relation de cause à effet entre la scarlatine et la péritonite. L'Italien BARTONE (1) indique aussi une fréquence étonnamment élevée de cette complication, à savoir 0.4 % de tous les cas de scarlatine.

BRETON est cité à plusieurs endroits comme l'auteur qui aurait décrit le premier la maladie, bien que SAINT-JUST, passablement avant lui, ait constaté une péritonite dans un cas de scarlatine. WEST parle déjà en 1875 de péritonite dans la scarlatine.

Les successeurs immédiats de BRETON sont MC COLLOM et K. B. BLAKE, en 1903, qui ont décrit deux cas avec péritonite fibrineuse. HECKER rapporta un cas en 1912, et TESSIER en cita cinq en 1914, tous traités par les moyens conservateurs et se terminant par la mort en peu de temps. DUNHAM en 1921 et NEWMAN en 1924 décrivirent chacun un cas, qui furent opérés et survécurent. La même année — en 1924 — PLATON relata l'histoire d'un malade chez qui une péritonite aiguë éclata au 20<sup>ème</sup> jour d'une scarlatine et qui mourut. KOJIS et MC CABE (10) en 1933 communiquent 3 cas traités par le sérum antiscarlatineux. Deux furent opérés, et



l'un de ceux-ci survécut et guérit. Un cas curieux a été décrit en 1935 par VUČETIĆ (22) de Belgrade. La scarlatine avait été diagnostiquée, et se compliqua de l'apparition de violentes douleurs abdominales avec des signes de péritonite. Un chirurgien consulté refusa d'intervenir. La guérison survint par perforation spontanée de la paroi abdominale, le pus s'évacuant par le nombril. Ce pus, à l'examen, se trouva contenir du streptocoque. Le malade fut traité par les moyens conservateurs, de sorte qu'on ne put jamais s'assurer s'il s'était agi d'un cas de péritonite scarlatineuse primitive ou pas.

L'Italien BARTONE (2), en 1935, a collationné un nombre assez grand de péritonites scarlatineuses, avec la description de 3 cas qui lui sont personnels. Tous ces malades furent traités par le sérum. L'un était un garçon de 10 ans, qui tomba malade avec les symptômes d'une péritonite et présenta par la suite une éruption sur le corps, rappelant la scarlatine. On pratiqua une paracentèse abdominale et il guérit. Dans un autre cas les signes de péritonite apparurent 15 jours après le début de la scarlatine. Ce patient-là mourut. En dernier lieu WASCHULEWSKA en 1942 a décrit un cas de scarlatine compliqué d'un iléus causé par un abcès intraabdominal. La guérison survint après intervention chirurgicale (23).

La péritonite scarlatineuse primitive apparaît la plupart du temps au stade de desquamation ou même plus tard. Dans 7 des cas cités elle est survenue à la période d'exanthème, voire a précédé l'exanthème. De toute façon ni le tableau clinique, ni l'évolution, ni encore le pronostic ne semblent être sérieusement influencés par le stade de la scarlatine auquel débute la péritonite. Dans les cas décrits plus haut, des streptocoques hémolytiques ont été trouvés dans l'exsudat péritonéal, dans le sang, ou dans les deux. A vrai dire, ces constatations n'apportent pas la preuve que la scarlatine ait causé la péritonite. Le nombre des scarlatines où l'on a mis en évidence une streptococcémie est, relativement parlant, très petit. C'est ainsi, comme on le sait, que SCHOTT-MÜLLER, sur un grand matériel, n'a réussi à prouver l'existence de streptocoques dans le sang que dans une minorité de cas: 2%. Le chiffre de KUNZEL est encore plus bas. Dans sa statistique, comprenant 5,500 cas de scarlatine, il n'a pu constater une streptococcémie que 42 fois, et dans son matériel on ne rencontre en tout et pour tout qu'un seul cas de péritonite scarlatineuse.

Dans la majorité des cas décrits dans la littérature — le nôtre

n'y fait pas exception — on n'a jamais fait de cultures du sang, ce qui se comprend aisément si l'on songe à l'évolution aiguë, parfois même suraiguë, de l'affection, et à la difficulté de la diagnostiquer.

Dans la plupart des cas publiés on a admis que la propagation de l'agent infectieux se faisait par la voie sanguine, mais la voie lymphatique, dans les péritonites «cryptogénétiques» de ce genre, a été considérée comme presque aussi vraisemblable (FLEXNER, GROTTI, KOJIS et MC CABE (9, 10). A vrai dire, la possibilité de l'invasion par le trajet bouche—canal intestinal («Durchwanderungsperitonit») a été citée (10), bien que dans aucun des cas relatés plus haut on n'ait pu en faire la preuve. Une infection a pu aussi se produire par la voie des organes génitaux, ce qu'en particulier ARMSTRONG, ainsi que KOJIS et MC CABE, ont essayé de faire ressortir (10). Cependant, sur les 19 péritonites scarlatineuses citées il n'y en a qu'une seule où, de toute façon, on ait quelque preuve de la réalité de pareil mode de propagation. Dans ce cas il existait une vaginite.

Les *autopsies* ont, à tout prendre, donné un résultat uniforme: péritonite à streptocoques typique avec absence — en tout cas macroscopiquement — de lésion primitive constatable, ou d'altérations grossières des viscères (1). De ce fait les foyers métastatiques ne se rencontrent pas en aussi grand nombre que dans les autres péritonites hémato-gènes. Dans un seul cas (celui de WASCHULEWSKA) (23) existait un abcès péritonitique localisé chez un garçon de 12 ans, tombé malade 4 jours après la disparition de l'exanthème avec fièvre élevée et tuméfaction des ganglions lymphatiques sous-angulo-maxillaires, et chez qui les signes de péritonite apparurent au bout de 5 autres jours. Chez lui on trouva des adénites lymphatiques dans le mésentère aussi, et les streptocoques purent être mis en évidence dans l'exsudat péritonéal. L'opération fut suivie d'une rapide guérison.

Le *tableau symptomatique* de la péritonite «primitive» liée à une scarlatine n'est pas non plus caractéristique au sens propre du terme, mais correspond à celui des péritonites streptococciques hémato-gènes. Les symptômes éclatent de façon singulièrement aiguë, et la détérioration de l'état général est plus marquée et plus prédominante qu'il n'est de règle dans d'autres péritonites. On a souligné que les diarrhées sont un symptôme précoce et typique de la péritonite qui nous occupe, bien qu'elles appartiennent aussi au tableau d'autres péritonites, où, à vrai dire, elles

apparaissent généralement plus tard. La douleur est habituellement diffuse dans tout le ventre dès le début de l'affection. Dans les cas décrits jusqu'ici on l'indiquait comme intense et à début violent. La température et la leucocytose ne diffèrent pas de ce qu'on trouve dans les autres péritonites.

Le *pronostic*, jusqu'ici, a été considéré comme très mauvais (quelques rares malades seulement ont survécu). Peut-être est-il devenu moins sombre avec la thérapeutique actuelle, mais — comme cela ressort du cas que nous avons décrit — l'importance d'un diagnostic précoce est extrême. Jadis on a estimé qu'une péritonite survenant tôt au cours d'une scarlatine était d'un pronostic plus favorable — c'était l'opinion des auteurs français TOURAINE et FENESTRE par exemple — mais cette idée a été révoquée en doute par d'autres, parmi lesquels TEISSIER (20).

Le *traitement adéquat* ne peut, naturellement, être que chirurgical, avec drainage de l'exsudat, chimiothérapie — Pénicilline — et toutes les mesures habituelles d'ordre général prises contre la scarlatine. Dans les publications récentes il n'est plus question de la paracentèse abdominale qu'on avait autrefois considérée comme une manœuvre opportune. Pas davantage ne peut-on aujourd'hui défendre le traitement purement conservateur.

### Summary.

The author reports on a case of primary scarlatinal peritonitis which is likely to have either occurred by haematogenic or by lymphatic dissemination of the infectious agent ( $\beta$ -haemolytic streptococcus).

In connection with the statement, an account is given on the literature that records pathology, symptomatology, and treatment of that form of disease.

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## Vagotomy for Peptic Ulcer.

Theoretical Background and Clinical Results.

By

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Surgical treatment is still required in many cases of ulcer, either because of intense and stubborn symptoms which do not respond to internal treatment or because of complications, *e. g.*, perforations, troublesome retention and dangerous hemorrhages. The surgeon generally has little hesitation about how to act in cases of complications, except in some instances of acute hemorrhage. Chronic ulcer, on the other hand, offers a much more complicated surgical problem.

A sharp distinction is made between duodenal and gastric ulcer in the Anglo-Saxon literature, the opinion being that the treatment of duodenal ulcer falls within the realm of internal medicine while the treatment of gastric ulcer is primarily a surgical problem. The main reason for this distinction is the tendency for malignant processes to develop in the gastric mucosa and the supposedly high frequency of malignant peptic ulcers. Another reason is that ulcerating cancer, unless seen by a surgeon, is often mistaken for gastric ulcer, with the result that it is not treated in time.

To my mind, however, this distinction is too onesided and schematic. The fear of the gastric ulcer becoming malignant is exaggerated more than necessary. My investigation of more than six hundred cases of gastric cancer (*Acta Chir. Scand.* vol. 10, 1942) with particular regard to the frequency of peptic ulcer which had become malignant, points rather to the infrequency of this occurrence.

Twenty per cent of these cases of gastric cancer had an earlier history of dyspeptic complaints of one kind or another. in 8.3 per cent of the

eases it was practically certain that gastric or duodenal ulcer was present before the development of the cancer, the supposition being based on roentgenographie evidence in many cases. In 2.1 per cent of the cases there was good reason to assume that the cancer had developed from an ulcer, and in 1.5 per cent the diagnosis of malignant ulcer was verified by histologic analysis.

It is obvious, however, that many not only gastric but also duodenal ulcers require radical surgical therapy even when no complications have developed. This form of therapy has also been used fairly often during the latter decades, mostly in the form of gastric resection according to Billroth's first or second method and their variants. The second method has perhaps been used more often, as most surgeons have found it to be followed by better results and less recurrences than the first method.

Whatever method is used, recurrences can never be entirely avoided, despite the most radical resections. Moreover, because of the desire to perform radical operation, the intervention often means great mutilation and the removal of large sections of normal gastric mucosa.

Accordingly, we must continue to search for more effective and less mutilating methods of treating gastroduodenal ulcers surgically.

### **Brief Analysis of the Etiology and Pathogenesis of Ulcers.**

As might be expected, attempts have been made to arrive at more effective therapeutic methods by analysis of the conditions favoring the development of "peptic" ulcer. Much research has been done on the etiology and pathogenesis of ulcers. GUENSBURG pointed out the significance of the acid gastric juice to the development of ulcers in 1852. Since then this factor, whence the term "peptic ulcer" (QUINCKE, 1879), has occupied a dominant place in every discussion on the causes of ulcer.

The importance attached to the peptic factor has varied from time to time. MOSZKOWICZ, KONJETZNY and coworkers believed that ulcerating gastritis was the cause of ulcers and denied the peptic factor all significance. VIRCHOW, HAUSER and VON BERGMANN assumed that the gastric juice caused ulcers but only when the gastric mucosa was injured in some way or less than normally resistant. The question of the peptic factor was again brought

up around 1930 by BUECHNER and his coworkers, whose interesting clinical and histopathologic observations showed it to be of decisive importance in the pathogenesis of ulcers.

In summary, it may be said that the intensive histopathologic, clinical and biochemical research of the past ten to fifteen years has shown beyond doubt firstly the complexity of the origin of ulcers and secondly the decisive part played by the acid gastric juice. It is now also generally recognized that ulcers are primarily dependent on a constitutional predisposition persisting throughout the life of the individual.

The importance of the peptic factor is verified by a series of clinical and experimental observations, a few of which I shall now briefly describe. For one thing, it is a common experience that the administration of alkalis often alleviates the patient's symptoms and also seems to facilitate the healing of ulcers. This clinical observation has been confirmed experimentally. Thus certain experimental conditions (administration of atophan) which otherwise almost invariably produce ulcers do not do so when alkalis are given simultaneously (cited from ASK-UPMARK).

Many years of intense study on the secretion in cases of gastroduodenal ulcer, gastritis and normal subjects have shown unequivocally that hypersecretion is much more common in cases of ulcer than in normal persons. DRAGSTEDT and his co-workers, among others, demonstrated that the abnormal hypersecretion was most pronounced during the night, when the stomach was empty. Thus DRAGSTEDT described cases secreting between 800 and 1200 cc. during the twelve night hours, as compared to between 300 and 400 cc. in persons with healthy stomachs. Moreover, DRAGSTEDT and others have concluded from their observations that it is the gastric hypersecretion and the hyperperistalsis often associated with it which give rise to the typical ulcer symptoms, hunger pains and so on.

Another circumstance considered to point to the significance of the peptic factor is the topographic situation of the ulcers. Thus they show a predilection for the nonacid-producing mucous membranes but in situations near the membranes which do produce acid. "Ulcers arise in the areas of activity of the gastric juice whereas the area of production possesses by nature a relatively high power of resistance" (BUECHNER). This fact has also been verified experimentally. DRAGSTEDT and his coworkers showed that when a surgical anastomosis was made between the stomach

and intestine, classical ulcers often developed in the intestinal regions then exposed to the influence of gastric juice.

LINDAU and I (Surg., Gynec. & Obst., 1931) showed, by clinical and pathologico-anatomical studies of cases with Meckel's diverticulum with an ectopic gastric mucosa, that ulcers regularly developed in the jejunum and ileum adjacent to the acid-producing Meckel diverticulum mucosa but never in the latter mucosa itself.

The rôle of the peptic factor is thus well authenticated, but it is also undeniable that neurogenic factors play a significant part in the development of ulcers. Our knowledge of the latter is mainly due to CUSHING's perspicacious observations. It is now assumed that the secretion and motility of the stomach are influenced by cortical impulses passing the vagus center in the medulla oblongata and the vagus nerves. CUSHING's observations in connection with cerebral surgery and later experimental studies have proved the importance of the latter neurogenic factor.

The first attempts to treat ulcer by measures mitigating or guarding against the peptic factor date back many years, and many different methods have been tried. The administration of alkalis has already been mentioned. Mucinous agents, atropine, Bellergal, Gynergen and several other substances have been used. They have been employed for the purpose of neutralizing the gastric juice, heightening the resistance of the mucosa to the juice or temporarily reducing the production of the juice.

All these agents, however, have only a *temporary effect*. If one could find some way permanently to neutralize or reduce the peptic factor, much would be gained in the fight against gastroduodenal ulcers. IHRE wrote in 1945: "There is no doubt that the ulcer problem would be solved as far as treatment is concerned if we were able to produce complete and permanent anaemia."

### Can the Peptic Action of the Gastric Juice be Permanently Reduced?

I have mentioned the importance of certain cerebral impulses to the motility and secretion of the stomach, seen particularly in operations on the brain. Experiments on animals have shown that stimulation of the vagus nerve causes an increased motor and secretory activity in the stomach. In other words, it causes the same conditions observed clinically in many cases of ulcer.



Similar stimulation of the vagus nerves occurs in the so-called insulin test, first elaborated for clinical use by IHRE. During this test the stomach shows hypersecretion and hypermotility. Investigations have proved that the hypoglycemia is the direct cause of the stimulation in these cases. If hypoglycemia is prevented by the simultaneous injection of glucose, no such stimulation occurs.

Many authors, including IHRE, say that the hypersecretion, and particularly the increased secretion of pepsin, the component of the gastric juice which is perhaps mainly concerned with the development of ulcers, may be due to an *increased vagal tonus*. In such a case, it is reasonable to assume that vagotomy would diminish or abolish this tonus and thereby diminish the cerebrally governed phase of the production of gastric juice. It is this reasoning which has led to the new form of treatment for gastroduodenal ulcers, viz., vagotomy.

It is interesting to note however that as early as in 1922 a Frenchman, PIERRE WERTHEIMER, in a dissertation "L'innervation et L'énervation gastriques", reported his experiences of vagotomy and denervation in gastroduodenal ulcers. He even presented perfect pictures of technical details. The results obtained in Lyon show an interesting resemblance to our recent experience. It should be observed, however, that WERTHEIMER reports a complete denervation of the stomach, that is to say not only the vagus but also the sympathetic nerve branches were served across. The casuistics comprised 23 cases.

DRAGSTEDT and his coworkers demonstrated by several years of experimental study that gastric hypersecretion and hypermotility is counteracted and partially inhibited by complete bilateral division of the vagus nerves. In 1943 they performed this operation in two human cases of gastroduodenal ulcer. The results were apparently good and as yet neither patient has had a recurrence. The operation had the same effect on the gastric motility and secretion of these patients as they had previously observed in their experimental animals. Since then DRAGSTEDT and other American surgeons (KEITH S. GRIMSON, FRANCIS D. MOORE, GEZA DE TAKATS, L. L. D. TUTTLE) have performed this operation in several other cases with apparently good results. DRAGSTEDT reported in March 1946 that about fifty cases of ulcer had then been successfully treated with vagotomy.<sup>1</sup> Rapid healing

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<sup>1</sup> By April 1947 DRAGSTEDT had used this method in about 300 cases with one recurrence.

of the ulcerous crater was observed in all except one case. Of course, the cases must be followed for a much longer time before anything definite can be said about the value of the method. The first operation was only performed four years ago and most of them were done during 1944 to 1947. We are only too familiar with the spontaneous variations in the course of ulcer disease, which may develop again after several years of complete absence.

The proposal of DRAGSTEDT and his coworkers to treat gastroduodenal ulcers with bilateral vagotomy — GEZA DE TAKATS and others had tried the method before but used inferior techniques — seems logical and is supported by several years of experimental investigation. The clinical results to date are promising. The operation is a mild one and relatively simple technically. Furthermore, vagotomy does not hinder future operations on the stomach and duodenum, and as far as is now known it has no directly injurious effect upon the gastric function.

It is true that cases have been described in which a considerable atony or hypomotility of the stomach was observed the first few days or weeks after vagotomy; unpublished deaths caused by this complication are said to exist. In quite a number of cases it has been necessary to perform gastroenterostomy in order to get rid of the dilatation. Lately, DRAGSTEDT has started to use permanent suction during 4 to 5 days after operation in order to avoid this complication. My own experience is positive on this point: only in two cases, in which a relative duodenal stenosis was present before the operation, a gastroenterostomy was considered to be necessary. I am convinced that in several cases of atony reported a relative stenosis existed in the duodenum before the operation, promoting this complication.

A man, aged 39, had suffered from ulcer distress for eighteen years, very intense during the last six years, or since 1939. In October of 1945 he was operated upon for a perforating duodenal ulcer. In March 1946 he again began to suffer from intense ulcer symptoms. Roentgenograms taken in August showed a greatly deformed duodenal bulb with an angular, bean-sized spot of contrast. There was some gastric retention, but the evacuation difficulties were not very great. When vagotomy was performed, however, these difficulties became very great and one month after the vagotomy, the usual posterior gastroenterostomy had to be performed. The duodenal bulb was then greatly deformed and showed considerable stenosis.

On the other hand, I have observed a fairly large number of cases of operations on the esophagus, resection of the stomach

and the like for both benign and malignant tumours in which both vagus nerves had to be resected but in which no such effect on the gastric motility was noted.

### Own Experiences.

Since June of 1946 I have performed supradiaphragmatic transpleural bilateral vagotomy in 22 cases<sup>1</sup> of gastroduodenal ulcer, mostly of duodenal ulcer. The operation was performed on extremely strict indications in each case. In most cases, if not all, there were strong indications for resection of the ordinary type. Thus all the patients had suffered for a long time from severe symptoms, including vomiting, most of them more than ten years. Several patients had had many large, life-threatening hemorrhages. Operation according to Billroth's first method or gastroenterostomy had been performed without effect in some cases, and perforation had occurred in others. The patients had all undergone innumerable cures both in hospitals and at home. In my first case, for example, operated on on June 12, 1946, there was a long history of intense distress and a niche, the size of a large pea on the posterior surface of the duodenal bulb and another almost the size of a hazel nut high up in the lesser curvature of the stomach near the cardia. This case was especially suitable for an attempt at vagotomy since, if an ordinary resection had been done and there were strong indications for this operation, total or at least subtotal gastrectomy would have been necessary.

### Technic.

Up to and including March 1946 (J. A. M. A. Vol. 130 No. 12, March 27, 1946.), DRAGSTEDT and his coworkers recommended the transthoracic supradiaphragmatic method of vagotomy because they found this method of operation to be safe and easy to perform. By degrees, however, DRAGSTEDT has changed technic entirely and seems now to prefer the abdominal approach. The reason was — and quite logically, too — that he wanted to expose the site of the ulcer and, in cases of suspected malignant (carcinomatous) degeneration, to be able to confirm or reject this suspicion.

As we all know, the vagus nerve branches are easily accessible just before their passage through the diaphragm, as they

<sup>1</sup> Up to November 1947. I have performed vagotomy in 40 cases.

pass along the right and left sides of the esophagus and before they spread out fanwise over the anterior and posterior surfaces of the stomach. The vagus nerves are here especially easy to attack even if they, as often happens, ramify into more than two trunks. It must be admitted that, from a technical point of view, the supra-diaphragmatic method is surer than the abdominal one, which, especially in cases earlier operated upon, is sometimes very difficult to perform and may prove unsuccessful. There is no doubt, however, that operative skill, a suitable incision and, for example, the use of eurare, facilitate the abdominal operation.

I have used the transthoracic route in 20 cases out of 22.<sup>1</sup> An incision is made over the left eighth rib which is resected subperiosteally from the cartilage-bone junction to 2.0 to 2.5 dm posteriorly. The pleural cavity is opened and the lung reflected upward after ligation of the inferior pulmonary ligament. As known, the left lung is attached to the diaphragm and mediastinal pleura, by this ligament at the place where the esophagus emerges between the pericardium and aorta. Ligation of this ligament generally causes a defect in the mediastinal pleura. I widen this defect with a Péan forceps or a scissors. It is then an easy matter to insert the left forefinger down in the loose tissue behind the heart and aorta and draw forth the lower part of the esophagus which is extremely mobile. As a rule both vagus nerves are then clearly exposed, running along the right posterior and left anterior surface of the esophagus as two white, millimeter-wide cords. However, I sometimes found when I drew out the esophagus that one branch of the nerve had been left behind. Renewed grip on the peri-esophageal tissue, however, always brought both nerves with all their branches into full view. It is important to expose all the branches of the nerve which proceed down to the stomach. Four or five centimeters above the diaphragm, the nerves have generally not yet begun to ramify. In one or another case, however, one or more separate branches are found running down the esophagus, generally on the anterior surface, and one must see that all the branches on both sides are collected. When this is done, a Péan forceps can be placed on each main trunk, and all the branches cut off just above the diaphragm. In my first case I resected 3 or 4 cm. of the nerve on both sides in order to obtain microscopic proof that it really was nerve tissue I had resected.

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<sup>1</sup> Up to Nov. 1947 in 38 cases out of 40.

To prevent regrowth I do the same as DRAGSTEDT and curve out both proximal stumps of the nerve and sew them to the pleura and pericardium, respectively. Only in the first case was any of the vagus removed. In the others, the nerve branches were only severed across.

In every case the operation down by the lower part of the esophagus, when the vagus nerves were drawn forth and cut off, was performed with practically no shedding of blood. Sometimes there may be bleeding from the small vessels running from the aorta direct to the esophagus when the esophageal tube itself is lifted forward, but this is soon stopped by the application of a few silver clips. After the vagus nerves are severed and their ends sewn down, the mediastinal pleura is closed with continuous catgut sutures. The thoracic pleura and wall are closed in the usual manner with continuous catgut sutures in the periosteum at the site of the resected rib and in the muscles.

Technically speaking, the operations were simple, the "skin to skin" time varying between forty-five and seventy-five minutes.

In my last 7 cases<sup>1</sup> I have employed a modified technic. Besides the transpleural supradiaphragmatic vagotomy the diaphragm is opened in a lateral direction so that an easy access to the stomach (and eventual ulcer) is obtained, thus avoiding the lack of control of the ulcerous regions that is the disadvantage of the supradiaphragmatic vagotomy. Technically the operations are easy to perform and the postoperative course did not cause more discomfort to the patients than the common supradiaphragmatic vagotomies.

No complications in the form of bleeding or infection in the wound occurred in any of my cases. As usual in operations on the thorax, there was a postoperative effusion in the opened pleural cavity. This required one to three punctures for complete resorption, one or two being generally sufficient. As a rule, it was necessary to make these punctures on the third or fourth postoperative day. Careful roentgen studies were made immediately after the operation and "bedside" roentgen studies made the next few days to see whether any effusion or pneumothorax had developed.

Intubation anesthesia with either ether and nitrous oxide or narcotal and nitrous oxide was used in most of the cases.<sup>2</sup> Both

<sup>1</sup> 25 cases up to Nov. 1947.

<sup>2</sup> In my last 5 cases I even have used curare with very good success. Technically the operations were facilitated.

methods were equally good. The use of intubation narcosis together with a spiropulsator (CRAFOORD, FRAENKNER, ANDERSON) made it easy to control the pulmonary function during the thoracotomy. Atelectasis was never observed postoperatively. The postoperative course was uneventful in each case, the reactions being very moderate. The patients left their beds between five and fourteen days after the operation, and remained in the hospital on an average of fifteen and a half days after the operation.

### Gastric Secretion Before and After Vagotomy.

The object of bilateral vagotomy in cases of gastro-duodenal ulcer being to lessen the gastric secretion and motility, it is extremely important from both a practical and theoretical standpoint that these conditions be given careful study after the operation. Even the most accurate postoperative studies only of the symptoms and roentgenographic appearance of the ulcer are often unreliable for judging the value of the form of therapy used. This applies not least to vagotomy. The spontaneous variations in the course of the disease make objective evaluations of these conditions difficult.

DRAGSTEDT used a series of tests to examine the motility and secretion in his cases. He examined the motility, for example, with a gastric balloon test. A catheter with an inflatable balloon was inserted into the stomach. The balloon was then blown up and the catheter attached to an apparatus which registered the contractions of the stomach. The secretion, which is perhaps the more important factor in these cases, DRAGSTEDT studied with several tests, *e. g.*, the histamine test, caffeine test, insulin test, measurement of the continuous nocturnal secretion and sham feeding.

I have not used the balloon test for measuring the gastric motility in my cases. To my mind, this test is extremely unreliable, other ungovernable circumstances having a large influence upon the results. In view of the difficulty of judging the value of vagotomy, it is important to use as exact tests as possible. After discussions with B. IHRE, whose wide knowledge in this field has been of great help to me, I decided to use the insulin and histamine test both before and after the operation. In the histamine test, as known, the gastric secretion is studied after intensive paren-

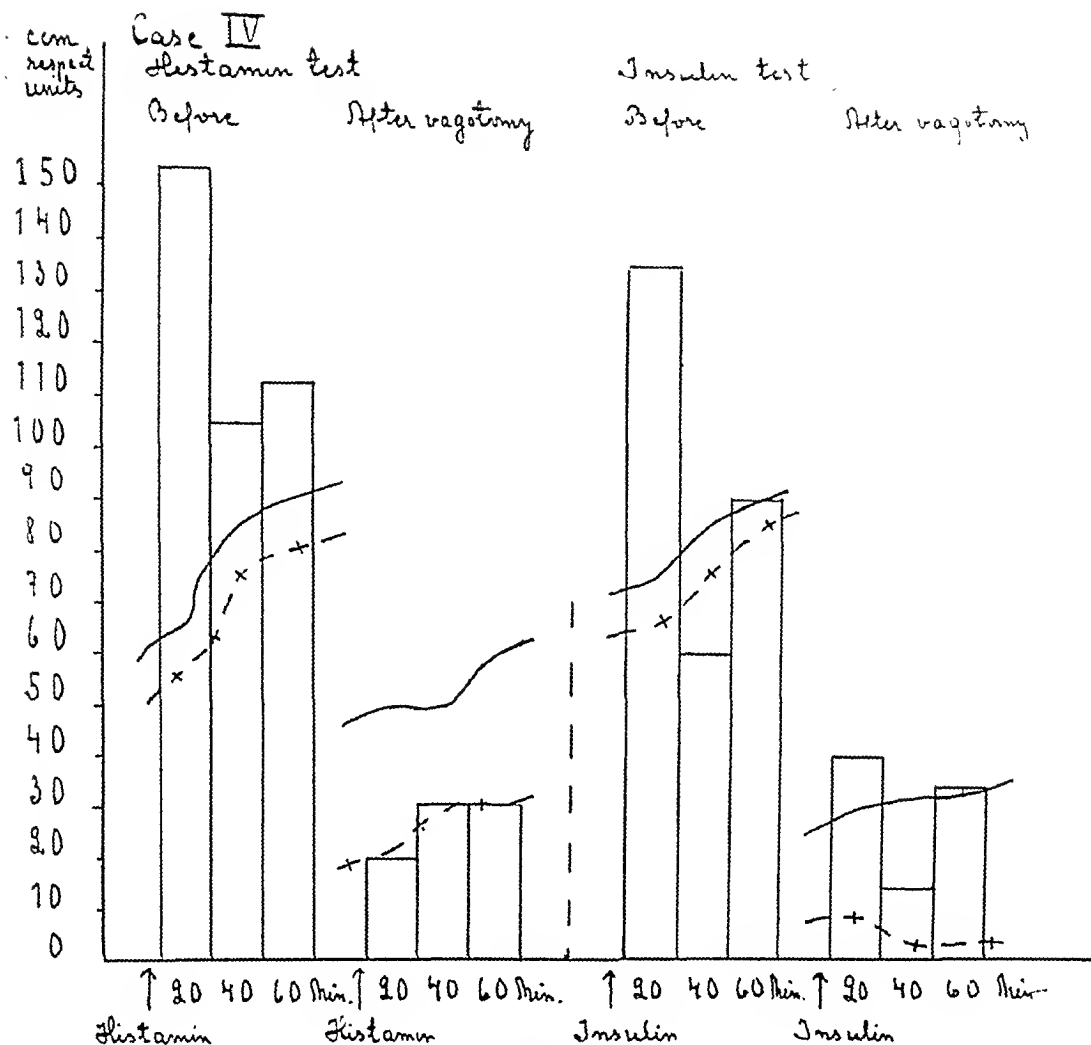


Fig. 1.

teral stimulation. The gastric mucosa is stimulated directly in this case. A special duodenal tube constructed according to IHRE is inserted in the stomach and a saliva pump attached. After the stomach is observed for retention and rinsed out, the gastric contents are sucked up and collected over a control period of twenty minutes. A subcutaneous injection of 0.9 mg of histamine is then given and the removal of gastric contents continued for another hour. The gastric juice is collected in three portions, each covering twenty minutes, and examined for amount, total acidity and free hydrochloric acid. These measurements were made according to IHRE's directions for clinical use of the method.

The insulin test was done in the same way. In this test it is the

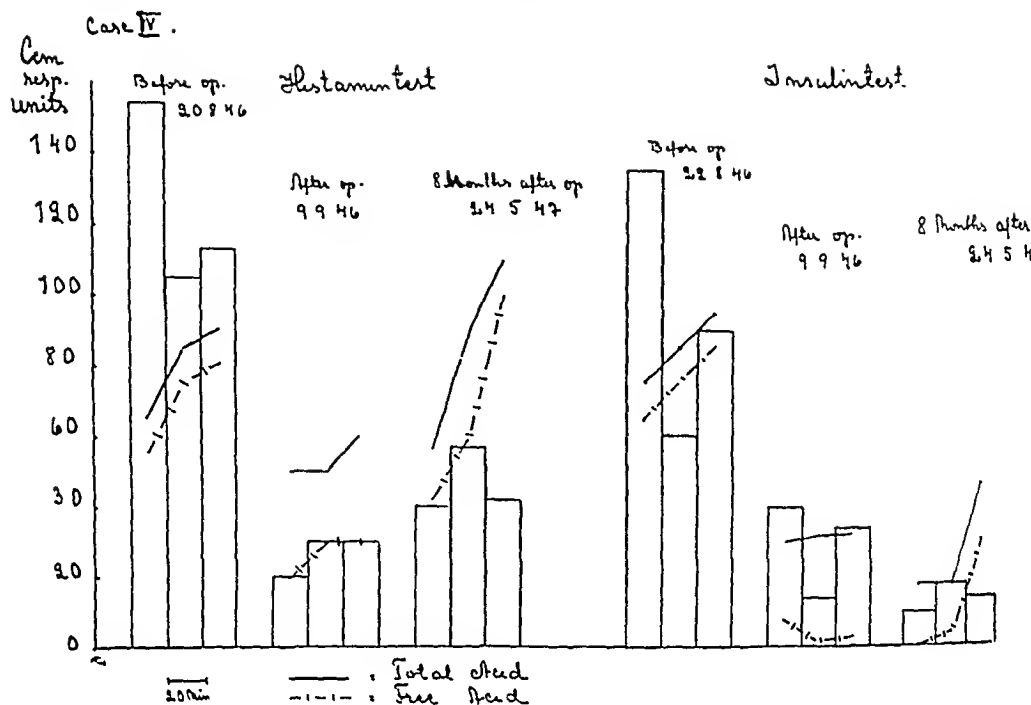


Fig. 2.

cerebral impulse caused by the hypoglycemia which, via the vagus center in the medulla oblongata and vagus nerves, stimulates the gastric secretion. It should be noted that, in the insulin test according to IHRE, it is mainly the secretion of pepsin which is stimulated. Sixteen international units of insulin were injected intravenously in each case, and the gastric juice collected continuously for one hour thereafter in three twenty-minute fractions.

Because the histamine test stimulates the gastric mucosa directly, theoretically it should show no mentionable difference in the gastric secretion before and after vagotomy. Some reduction could be expected when the cerebral phase of gastric secretion is abolished, however, for no matter what test is used, the cerebral mechanism probably always participates to some degree in the stimulation of the secretion. On the other hand, the insulin test should show much less secretion after than before vagotomy. On the whole, my observations have verified those of DRAGSTEDT. The following diagrams together with brief case reports exemplify what has just been said.

*Case 4.* — A man, aged 29, had had intermittent periods of ulcer distress for four years. Roentgenograms taken on four occasions showed



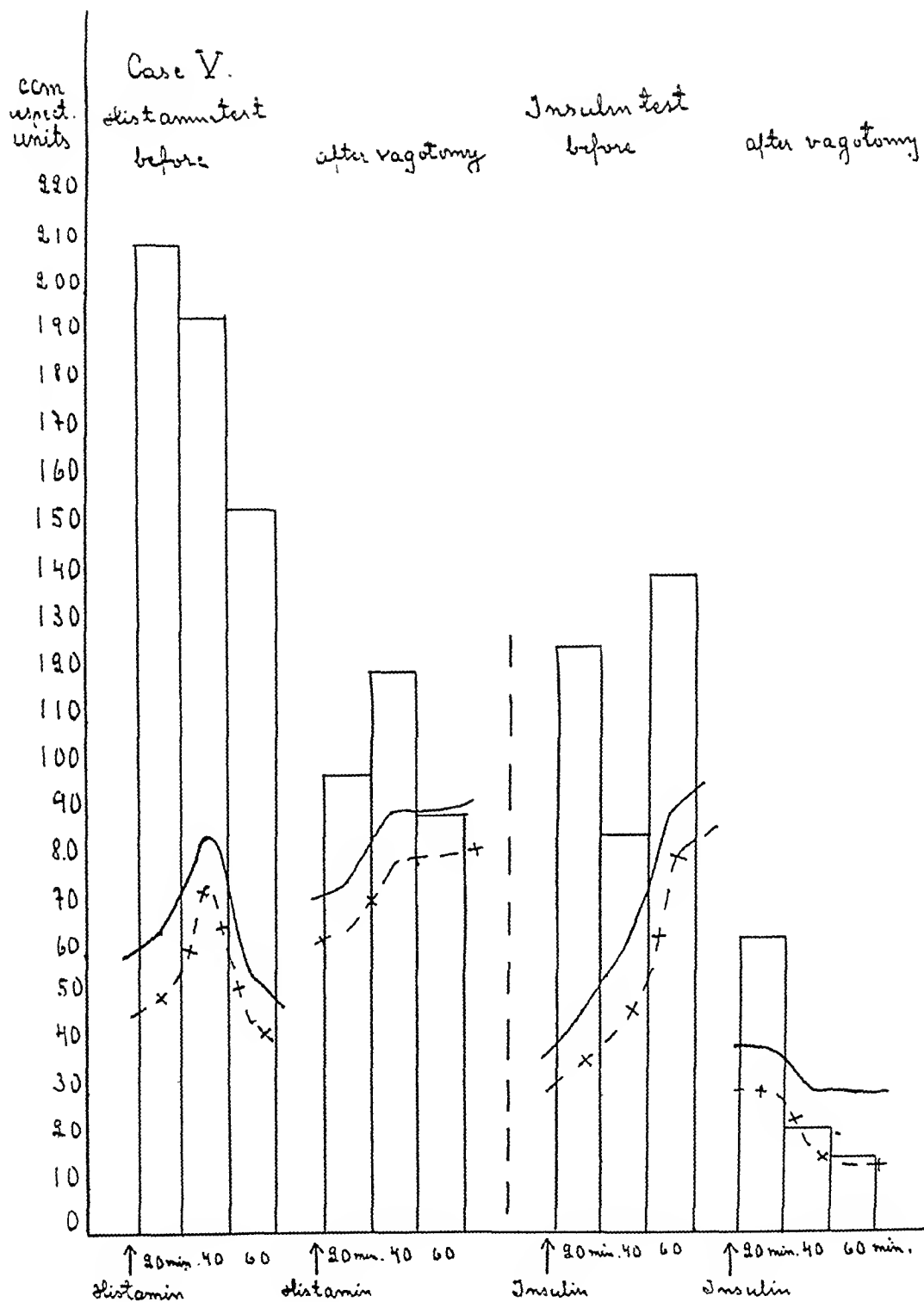


Fig. 3.

## Case VII

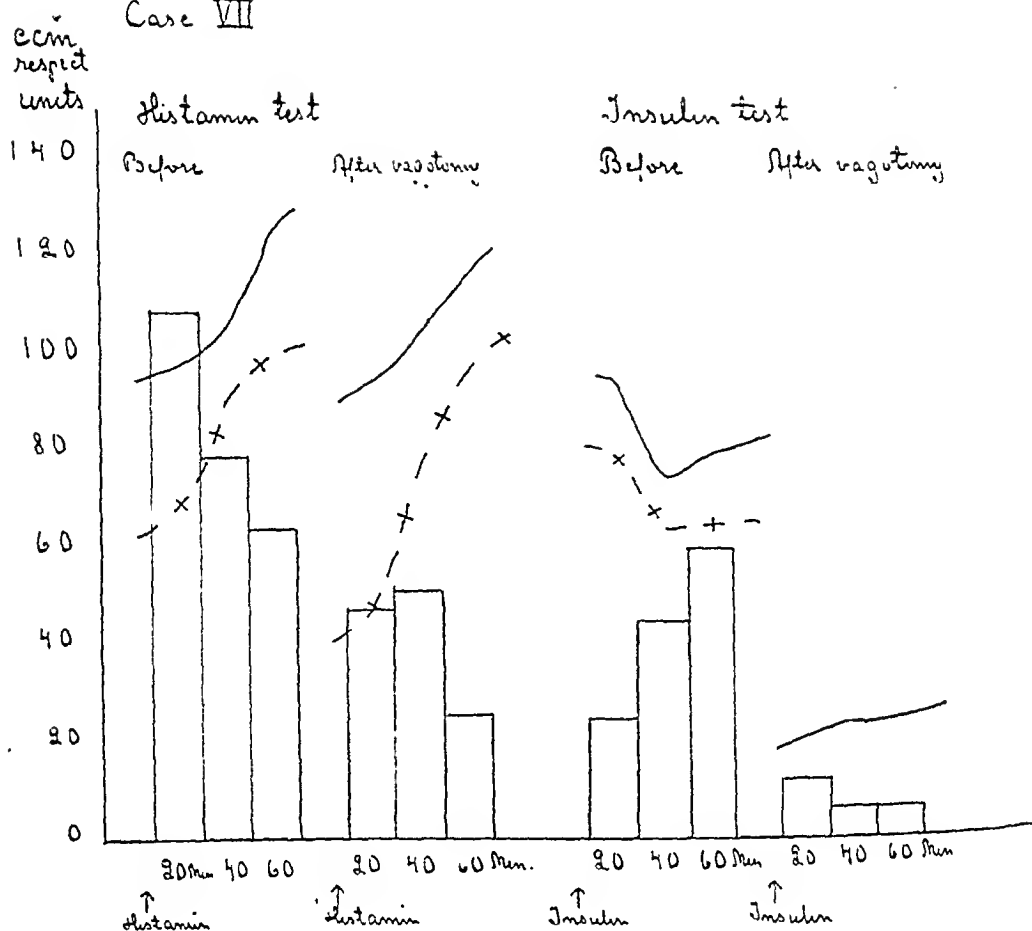


Fig. 4.

duodenal ulcer. He went through four strict cures each followed by healing of the ulcer. He was admitted on July 14, 1946 complaining of renewed and intense ulcer symptoms for the previous week. The insulin and histamine tests according to IHRE showed considerable hypersecretion and high values for acidity (fig. 1). On August 28 supradia-phragmatic transthoracic vagotomy was performed. The postoperative course was uneventful. After the operation the amount of secretion diminished and lower values for acidity were obtained (fig. 1). He was discharged on September 12. About a month later the ulcer had healed. 10 months after operation quite healthy. Gastric secretion low even values for acidity (fig. 2).

*Case 5.* — A Swedish American, aged 37, had suffered from ulcer since 1935. Many hemorrhages had occurred, the last one in 1939. In 1940 antecolic gastroenterostomy was performed at the Mayo Clinic. On August 1, 1946 a new hemorrhage occurred. He was admitted on August 18, 1946 complaining of severe epigastric pain for the last months. The insulin and histamine tests according to IHRE

showed considerable hypersecretion and high acidity values (fig. 3). On August 30 supradiaphragmatic transthoracic vagotomy was performed. The postoperative course was uneventful. The histamine and insulin tests eleven days after operation (fig. 3) showed cessation of the hypersecretion and lower values for acidity. A pyloric deformity was demonstrable at the time of the operation, but no niche was seen. There were marked signs of gastric dumping. 12 months later the patient's condition had improved greatly; the pain had disappeared and no new hemorrhage had occurred. The histamine and insulin test 3 months after operation still showed cessation of the hypersecretion and lower values for acidity.

*Case 7.* — A man, aged 49, with ulcer symptoms since the autumn of 1911. Roentgenograms showed a niche in the duodenal bulb. The patient had undergone several ulcer cures. He was admitted on September 25, 1916 complaining of intense ulcer distress for several weeks. Roentgenograms taken September 30 showed a crater the size of a split pea in the posterior duodenal wall. There was no definite dilation of the stomach and no residue after four hours. The histamine and insulin test according to IMRE exhibited considerable hypersecretion and high values for acidity (fig. 4). On October 7 supradiaphragmatic transthoracic vagotomy was performed. The postoperative course was uneventful, and the patient was discharged healthy on October 26. The histamine and insulin tests then showed much less secretion and lower values for acidity (fig. 4). Roentgenograms still showed a niche but there was no retention. On re-examination on May 10, 1917, the patient had no pain and the ulcer niche was then no longer visible. The histamine and insulin tests showed still much less secretion and lower values for acidity.

The histamine and insulin tests before and immediately after vagotomy are recorded in the preceding diagrams. In 20 cases these tests could be carried out at varying length of time after the operations; in 8 cases the tests were made 6—8 months after vagotomy. Diagrams 1, 2, 3 and 4 give the results obtained in type cases. The remaining cases showed the same agreement.

Thus, 8—12 months after operation, the insulin tests still revealed same decreased gastric secretion and considerably lower values for acidity as immediately after the operation, a fact which, in my opinion, greatly strengthens the indications of vagotomy being performed in certain cases. Naturally we need longer experience; further gastric secretion tests after two, three years will show if really the change in the gastric secretion is permanent or not.

## Clinical Results.

The gastric secretion, as we have seen, was favorably influenced by the operation in my cases, even 8—12 months after vagotomy. We shall now turn to the clinical results. Naturally, these results can only be regarded as preliminary, for the first case was only operated upon 14 months ago. As yet, however, all the patients except two have felt well since their operation. It is quite certain, even when full consideration is given to the mental influence which such a large and dramatic operation may have upon the patient, that the pain which in many cases was very stubborn has disappeared completely. Many of the patients said that they have not felt so well since ten years before the operation.

As regards the disadvantageous postoperative sequels, the serous pleural effusion, as mentioned before, was only slight. Only in one case were three punctures necessary, the others requiring only one or two.

In two cases, however, distinct signs of increased motility of the small intestine were observed postoperatively, the patient having a desire to defecate as many as ten times a day during the first few days after the operation. The increased motility persisted for five or six weeks after the operation in one case, but during the last week or so was only manifested in a desire to defecate four or five times a day.

In two cases the duodenal bulb was considerably deformed before the operation, and there was also some stenosis, though it was perhaps not given sufficient attention. After the vagotomy, however, this "pyloric obstruction" became more evident, probably because of the reduced gastric motility. There being no mentionable improvement after six weeks, the gastric retention persisting and the bulb still showing considerable deformity, gastroenterostomy was done; the symptoms then disappeared completely. It might have been suitable in these cases to have taken the abdominal route for the vagotomy and perform a gastroenterostomy at the same time.<sup>1</sup>

In 15 cases a distinct, open ulcer crater was observed just before the vagotomy. In one case there was a crater the size of a finger tip on the posterior surface of the duodenal bulb and an ulcer the size of a hazel nut high up in the lesser curvature. In

<sup>1</sup> In my last seven cases I have changed the technic through which a control of the gastroduodenal lesions at the vagotomic operations is always possible.

seven cases the niche was in the duodenal bulb, in three cases in the stomach only. In four cases greater or lesser craters were in the jejunum (operated cases). Healing was relatively rapid in all the cases, taking three weeks, up till two months. There was no open sore in six cases before the operation, and nor were any observed in the roentgenograms taken afterwards. In one case operated upon earlier (Billroth II) with repeated haemorrhages no ulcer was observed before operation.

### Discussion.

Naturally many objections can and will be made to the use and value of vagotomy for gastro-duodenal ulcer. But these objections can only be theoretical as yet. We still know nothing about *the late results*. Of course, we know from experience in other fields that operations on the sympathetic and parasympathetic system often have a relatively short-lived effect. In addition, many other factors than the peptic action of the gastric juice participate in the development of ulcers. Furthermore, it is difficult to judge the value of vagotomy, like every other form of therapy, because of the prolonged remissions which often occur spontaneously in the course of ulcer disease.

The only way to learn the real value of vagotomy for treating gastro-duodenal ulcer is to carry out an unprejudiced investigation over a period of years. An investigation of this kind, set up on a broad basis, is now under way at our hospital in Malmö.

### Summary.

After a review of the theoretical grounds for the use of supra-diaphragmatic vagotomy for treating gastro-duodenal ulcer, the author describes the results to date in his first twenty-two cases treated in this manner. These results confirm on the whole the experimental and clinical results of DRAGSTEDT and his coworkers and other American surgeons. The operation caused the desired reduction in gastric secretion, up to the time of writing at any rate — results 8—12 months after vagotomy — and objective proof of the ulcer having healed was obtained in each case. There was also a distinct symptomatic improvement in every case. The results are promising.

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## Surgical Treatment of Polycystic Kidney.

By

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Some years ago, polycystic kidney was still considered mainly as a curiosity, of interest only to pathologists and scientists who attempted to analyse the aetiology of this strange transformation of the renal parenchyma. In due course, the disease attracted the attention of clinicians, and it is now possible to establish a diagnosis at an early stage. Since surgical intervention, with opening of the cysts, has at times resulted in a symptomatic improvement even in advanced cases, therapeutic nihilism has given way to guarded optimism. Increased knowledge of the disease has altered the opinion regarding the prognosis in polycystic kidney. At the same time, new material has been available, thus contributing to the discussion which is still in progress as to the nature and origin of the disease.

In one thousand post-mortems one or two cases of polycystic kidneys are found. GRUBER (1928) in Mainz found a higher frequency, *i. e.* eight cases in 3,500 autopsies. In spite of the increased morbidity of polycystic kidney patients, the diagnosis is not made to this extent on clinical examination. The Mayo Clinic reports 193 clinical diagnoses in 680,000 patients, *i. e.* the disease is found in one out of every 3,500 patients. The above figures show that cases of polycystic kidney should occur once a year in the material of every relatively large hospital, if the disease is borne in mind when making an examination. VALLERY-RADOT (1943) mentions that nine cases of polycystic kidney were seen in two years at the Hôpital Bichat of Paris. The disease is thus not uncommon.

It is now generally held that polycystic kidney is to be regarded as a malformation. Earlier theories regarding its pathogenesis are only of historical interest. Amongst these is VIRCHOW's hypothesis of a foetal inflammation, the "papillitis stenosans", which would result in a reactive formation of connective tissue with obstruction of the urinary channels and formation of retention cysts. We also have the tumour theory, which regards the polycystic kidney as a cystadenoma. This theory was for a long time supported by many well-known clinicians, among others LÉJARS. The conception now generally held that polycystic kidney is caused through a developmental defect was brought forward already in the early eighteen-fifties. Opinions differ, however, concerning the formal origin of the cysts. RIBBERT and other "non-unionists" consider that there is a defective fusion of the two constituents of the kidney: the secretory part from the metanephros and the excretory part from the ureter. A mere inhibition of the growth should, however, result in atrophy of the organ. Many authors have therefore assumed that a tumourous growth may exist in addition to the malformation. HERXHEIMER and others are of the opinion that polycystic kidney is a kind of hamartoma, *i. e.* a tumour in which the normal elements of the tissues are present with the usual histological characters, but with abnormal distribution and quantities. Hamartoma thus lies between a malformation and a tumour. Other authors emphasize that the developmental defect of the renal parenchyma can only arise when fusion of the two constituents of the kidney has taken place, each being essential for the development of the other. An inhibition of either part leads to aplasia, not to the formation of cysts. McKENNA has demonstrated that there is normally a regression of those convoluted tubules which are connected with the primary generations of collecting tubes. The cystic degeneration of the renal parenchyma may arise from this process. If we assume the existence of a force which controls the differentiation of the tissues at the period in question — the third foetal month — it is possible to find, in a damage to this force, a common explanation of the often simultaneous appearance of cystic degeneration of the kidneys, liver and pancreas. Of great interest is the affinity demonstrated by LINDAU (1926) between polycystic kidney and cerebellar cysts in angiomatosis retinae, the so-called von Hippel-Lindaus' disease. LINDAU pointed out that angiomatous cerebellar cysts are often simultaneous with cystic pancreas or polycystic kidney, and also



frequently with hypernephroma. "Sämtliche Neubildungen dürften auf eine Bilanzstörung in der Entwicklung des Mesoderms, entstanden im dritten Embryonalmonat, zurückgeführt werden können." The affinity between tumours and dysontogenetic changes has also been emphasized by CLEMMESSEN (1942), who reported on a family in Copenhagen with polycystic kidneys. Hypernephroma occurring simultaneously with polycystic kidney was diagnosed in the father and two of the children. Like so many other malformations, polycystic kidney can be hereditary, and the disease often shows a familial occurrence. Reports on polycystic kidney families have been published from different countries. It is, however, natural that information concerning the various members of the families is often defective, and seldom embraces more than two generations.

Of great interest are the investigations made during the past decade, which have shown that the contents of the cysts are not a simple transudate, but are instead formed by filtration into a still active glomerulo-tubular system. Such investigations have been published by LECLERC-DANDOY (1938) who determined the urea, the chlorides and the creatinine of the blood, the urine and the contents of the cysts. LAMBERT and CAMBIER (1939) have further shown, by means of injections of Indian ink and trypan blue, and subsequent histological examination, that the cysts communicate with convoluted tubules which retain the colloidal dye particles in a manner specific for these tubules. LAMBERT and MULLER (1939) showed that puncture of the cysts, after massive doses of creatinine or inulin yielded creatinine and inulin values which were higher than those in the blood serum. The cysts must, consequently, have a concentration capacity of the same kind as the tubules. This capacity varies for different cysts, and the values obtained differ from one cyst to another in the same organ.

The pathological changes in polycystic kidney are so well-known that a detailed description is unnecessary here. Attention may, however, be drawn to the fact that unilateral cases undoubtedly exist. In addition, there are cases where the malformation is localized to one part of the kidney, thus allowing resection of the diseased portion, with retention of the rest of the kidney. Polycystic kidneys appear to occur as frequently in men as in women. In the operation material, a higher frequency of women is often found, as for instance in the reports published by SCHMIEDEN.

Formerly, clinicians differentiated between polycystic kidney disease in children and a similar condition in adults, which latter generally appears after middle age. It is, however, the same disease in both cases. Polycystic kidneys in the foetus can cause premature labour, often with intrauterine death. When the child is born alive, the symmetrical enlargement of both kidneys is, as a rule, easily recognised. The prognosis is poor in such cases. The child usually dies from renal failure after a short time. If the child does survive, the disease is surprisingly often unilateral. (FÈVRE and VAN HOA, 1945.) In these cases, where the enlargement of the kidney is palpable on one side only, the mass is often mistaken for a malignant tumour of the kidney or the abdomen, since malignant tumours of the kidney are comparatively frequent in children. The report published by SÖDERLUND and WAHLGREN (1932) of a cystic tumour of renal origin in the kidney region gives an idea of the difficulty of diagnosis. Incidentally, the disease can be found in children with pyuria of long standing, where a tumour is not palpable. Unilateral cases of polycystic kidney in children can often be nephrectomized with satisfactory, immediate results. FÈVRE and VAN HOA have published nine such case-histories. With regard to the fact that small cysts, which are later apt to enlarge, can exist in the remaining kidney, the prognosis must, however, be considered as uncertain. In adults, the diagnosis is generally made between the age of forty and sixty years, although the disease can be found earlier, as well as later. It has sometimes been demonstrated in old people, without the presence of any clinical symptoms. The typical picture of the disease resembles that of chronic nephritis. It shows, however, some special features worthy of mention. The disease runs its course with a progressive impairment of renal function, which accelerates during the periods of rapid enlargement of the cysts. The concentration capacity first decreases, and isosthenuria finally results. This can exist for a long time before the appearance of true renal insufficiency. Finally, however, the non-protein nitrogen rises, and the disturbances in blood chemistry connected with uraemia, acidosis, retention of phosphates and sulphates, appear. It must be pointed out that *this development occurs with unimpaired general condition*. No renal disease can show such high figures of non-protein nitrogen with satisfactory general condition as polycystic kidney. Patients with isosthenuria and moderately increased non-protein nitrogen maintain their capacity for work for years. If a correct

diagnosis is not made, final deterioration with a fatal issue comes at times quite unexpectedly. In such cases, post-mortem reveals the cause in the shape of a far-advanced cystic degeneration of the kidneys. The small amount of functioning renal parenchyma compatible with life is then surprising to the clinician. Patients who are examined in the uraemic stage suffer from albuminuria, erythrocytes and casts being demonstrable microscopically. Their subjective symptoms are fatigue, headache and nausea. Chronic nephritis will often be diagnosed. As VALLERY-RADOT has pointed out, *palpation of the renal regions* — an examination too often neglected in chronic nephritis — *often gives the correct diagnosis* in such cases. Of great interest is the state of the blood pressure in these patients. It was formerly asserted that the blood pressure was generally increased in polycystic kidney. Later investigations have shown that *only a small proportion of such patients have hypertension*. HOLLÓ and KOLBENHEYER (1940) were able to find increased blood pressure in only nine out of 36 patients. The increase was in many cases only very slight. Such hypertension was formerly considered to be due to renal failure, but this is an erroneous conception. Only two out of 16 patients with increased non-protein nitrogen in the material of HOLLÓ and KOLBENHEYER suffered from hypertension. Increased blood pressure can be found in young patients and is — for this reason among others — not of the same kind as in essential hypertension. KYLIN has assumed a coexisting nephritis as the cause of hypertension in polycystic kidney. His theory has gained few supporters. Several authors are of the opinion that this is a question of hypertension due to renal ischaemia, in other words, a Goldblatt mechanism. The ischaemia would result from a sudden rise of pressure in one or more cysts. It should finally be pointed out that retinopathia is said to be rare in polycystic kidney (VALLERY-RADOT). An advanced hypochromic anaemia can exist, as in other patients with very impaired renal function. SMITH and GRAHAM have recently called attention to this fact in connexion with a published case, where anaemia was the most prominent symptom. The anaemia is proportional to the increase of the non-protein nitrogen, and is generally held to be the result of toxic damage to the bone-marrow, caused by uraemia.

In dealing with a material where diagnosis was made and treatment begun during the final, uraemic stage of the disease — a material of the kind described above — a gloomy picture of the

prognosis is obtained. When the material consists of patients in which the diagnosis was accidentally revealed during an early stage of the development of the polycystic kidney disease — usually as a consequence of infection, haematuria or an attack of pain — the impression is quite different. The material in a surgical clinic is, therefore, more amenable to treatment than that of a medical clinic. Active surgical treatment is often more effective than could at first be expected in a disease of this kind.

It is particularly PAYR who has emphasized the fact that acute symptoms can arise in polycystic kidney, in the form of fever and severe pain. The temperature can rise to 40° C. in a few hours without the presence of serious infection. The pains are severe and are caused by rapid swelling of the kidney. The patient may have attacks of vomiting and poor general condition. The attack is consequently similar to the acute retention in the kidney such as occurs in hydronephrosis or renal colic from ureteral calculus. PAYR himself compared this with the torsion in floating kidney. The attack characteristically subsides during treatment with anodynes and antispasmodics. According to PAYR, hyperpyrexia need not signify suppuration. It is only in continuous fever and lasting leukocytosis, when abscess formation is likely, that there is any indication for surgical intervention. The attacks described by PAYR can be caused by a series of conditions, which nowadays are open to analysis and to individual treatment. Some are possibly brought about by haemorrhage in the cysts or by other disturbances of circulatory or secretory character. Certain attacks are no doubt caused by the escape of concretions or small blood clots. Finally, inflammatory changes to which polycystic kidney is extremely liable, can be possible.

Clinical diagnosis in the advanced cases of the disease mentioned above is made by palpation of the kidney region, where the typical bilateral tumour with smooth or — in large cysts — somewhat irregular surface is found. This symptom was positive in eight of the nine cases published by VALLERY-RADOT. On the other hand, X-ray examination is indispensable for an *early* diagnosis, which should be aimed at. It is of special value to establish the diagnosis before any considerable impairment of the concentration capacity has taken place. HENNINGER and WEISS (1938) devoted an excellent study to the roentgenological symptoms of polycystic kidney. Plain roentgen examination which may show enlarged kidneys, is rarely sufficient for the diagnosis. Contrast filling of

the pelves is as a rule necessary, either through intravenous urography or through retrograde pyelography. The latter method should be used on one side at a time. Intravenous urography can be used only when the concentration capacity of the kidneys is maintained. Normal non-protein nitrogen, and preferably a concentration test showing satisfactory specific gravity of the urine, are thus essential. The urograms will be indistinct if the concentration capacity of the kidneys is unsatisfactory. Moreover, with very impaired renal function, the contrast medium can have a deleterious effect on the kidneys. VALLERY-RADOT has described a death from uraemia following an injection of ténébryl in a polycystic kidney patient with raised non-protein nitrogen. The retrograde pyelogram is therefore preferable in doubtful cases. It always gives a better picture of the pelvis than the intravenous urogram. It must, however, be carried out with the utmost cautiousness on account of the very great risk of infection in such cases.

Polycystic kidney has — in contrast to, for instance, hydro-nephrosis — no uniform, typical roentgen picture. Some features are, however, somewhat characteristic. LICHTENBERG and others have called attention to the elongation of the neck of the calyx, which is very characteristic if it involves several calices. The calyx itself shows at the same time a rounded dilatation. Such a calyx may, through the development of small additional cysts, be flattened down to the shape of a bowl, or have a rounded filling defect, the “encoche” of French authors. The pelvis appears increasingly intrarenal and shows a funnelshaped deformity. On account of the changes of the calices, the pelvis appears amply ramified. German authors talk of a “hyper-ramification”, American authors of a “dragon deformity”. It has also been asserted — somewhat incorrectly — that the pelvis is lacking, and that the ureter immediately fuses with the calices. Since the volume is augmented, the kidney is displaced laterally and the longitudinal axis is more parallel to the spine than to the psoas margin. In early cases the urogram naturally shows very small changes from the normal roentgen picture. The pictures obtained of the “healthy” kidney in asymmetrically developed disease are, in this respect, very instructive.

It is often pointed out, even by surgeons, that the treatment should as a rule, be conservative. This means that the patient should avoid exertion and excessive temperatures. Mental and

physical rest are essential. It is customary to prescribe a dietetic regime similar to that in chronic nephritis. Since the disease is, of course, progressing more or less rapidly, it is difficult to assess the value of this medical treatment in individual cases. Adjustment to as quiet a life as is compatible with individual social conditions should, however, benefit the patient. All over-nourishment, especially with foodstuffs rich in protein and salt, is an unnecessary load on the already overstrained renal parenchyma. As long as the concentration capacity remains satisfactory, excessive intake of fluid should be avoided. When isosthenuria is imminent, fluid sufficient to bring about a secretion of the decomposition products of the metabolism, must of course be supplied. Courses of treatment in hospitals or sanatoria are, as a rule, scarcely necessary.

Views differ as to the surgical treatment of uncomplicated cases of polycystic kidney disease. The operation technique is the exposure of one or both kidneys with opening of as many cysts as possible. This can be done by puncture, by excision of the cyst walls, or by cauterization. Etching of the cyst walls with various corrosives is used to prevent the formation of new cysts. A method of suturing the kidney to the scar, in order to make the enlarging cyst accessible for a new intervention, has also been described.

These conservative operations were introduced about 1910 by ROVSING, MARION, PAYR and others, and an operation of this kind is thus often named ROVSING's operation. At first, the intervention seems to have been regarded as an emergency operation, an extremely palliative intervention. It was not recommended as a standard method, although the results were satisfactory. This was probably due to the prevailing conception of polycystic kidney disease as an incurable disease of progressive nature with a poor prognosis. Moreover, such an intervention, with the anaesthesia of those days, lacking the possibility of treating a disorder of the fluid equilibrium, must have appeared dangerous. During recent years, opinions regarding the prognosis have changed, and the operative risk has diminished. Moreover, the operation has become more common, particularly in the U. S. A. Operation appears to be clearly indicated in cases where there is rapid destruction of the kidneys, with imminent or apparent uraemia. Renal function has at times been restored in an amazing way, even in fully-developed isosthenuria (HENNINGER and WEISS

1939). It seems irrational to prescribe — as do many authors, among them even enterprising surgeons — a dietetic regime in incipient uraemia, when there is everything to gain and nothing to lose by an operation.

It has already been pointed out that patients with polycystic kidneys are often subject to complications which demand surgical treatment. An *infection* should be treated with chemotherapeutics as long as it is low grade, and a septic state is not imminent. The chances that such treatment will be successful are, of course, limited, when the concentration capacity of the kidneys is reduced, or when the contents of a cyst are infected. A perinephritic abscess must be drained as soon as possible. If the state of the patient demands further intervention, nephrostomy is sometimes performed, as a rule with poor outcome. Nephrectomy is preferable, and is then performed on vital indications, although the risk of failing renal function in the future is evident.

Polycystic kidneys may cause severe and possibly fatal *haemorrhages*. An instructive case was published by GEJROT (1939). The patient was a young man with severe haematuria originating from the left kidney. This was exposed, and the cysts were opened to such an extent that the large mass was reduced to the size of a normal kidney. The bleeding stopped immediately. Some months later, haematuria recurred, although not so seriously, and with spontaneous cessation. The method used by GEJROT is that generally recommended. It is evident that nephrectomy should only be performed in exceptional cases (LOWSLEY, 1945).

*Concretions* formed in a polycystic kidney must be treated along the usual lines. It has been pointed out by various authors, among others LOWSLEY, that open operations such as ureterolithotomy are preferable to cystoscopic manipulations when the nature of the calculus makes an intervention necessary.

Opinions differ still more regarding the management of patients who show fairly good renal function with signs of progressive damage to the kidney. LOWSLEY is of the opinion that operation may be performed if the deterioration of renal function appears to be rapid. An operation is not justified when control examinations show only slow deterioration over a long period of years. BRAASCH takes a similar view, and emphasizes that the improvement of renal function after the intervention is sometimes poor, and that complications may occur which render a secondary nephrectomy necessary.

In order to illustrate the results and the risks of the operation, three case-histories from the writer's own material are given below:

*Case 1.* G. S., a woman, b. 1896. The patient was taken ill in March 1940, with pain in the left side, resembling that of renal colic. She was admitted on 3. 4. 1940 to the Alingsås Hospital. Roentgen-examination revealed an enlarged left kidney, with deformity of the pyelogram as in a tumour. The pyelogram was normal on the right side. The urine from the left kidney was strikingly pale. The patient was operated on 23. 4. 40. (BRANNBURE). A considerable number of cysts were found in the left kidney. Relatively much functioning parenchyma was still present. The cysts were opened and the outer walls excised. The cavities were painted with "varicocide".<sup>1</sup> The wound was sutured, with drainage of the kidney region. The postoperative course was on the whole normal. On conclusion of treatment the urine was sterile. The enlargement of the left kidney was still palpable. In 1941, the patient was operated on for uterine myoma with supravaginal amputation. In 1942 she had a new attack of pain in the left side. Examination revealed leucocytes and bacteria in the urine, a concretion large as a pea in the left pelvis, and defective excretion from the left kidney. Vollhard's test showed a maximum concentration of 1.013. N. P. N. 52 mg%. The patient has since then had no symptoms, and has carried on her customary clerical work. Follow-up examination on 31. 10. 1946: the sediment contained numerous leucocytes and coli bacteria. Specific gravity 1.021. N. P. N. 38 mg. B. P. 160/100. Intravenous urography revealed the occurrence of cysts deforming the left pelvis and a cluster of concretions situated in a separate cavity belonging to the pelvis. This was divided into two parts, of which only the lower and larger showed some filling with contrast.

*Case 2.* S. J. A., a woman, b. 1898. Treated in hospitals in 1928 and 1936 for pyelitis. In 1937 supravaginal amputation for uterine myoma. The patient was admitted on 17. 2. 1938 to the Maria Hospital with fever, abdominal pain and haematuria. Both kidneys were enlarged on palpation. The right kidney was larger than the left. The urine from both ureters was infected with coli bacteria. N. P. N. normal. Vollhard's test: 1.004—1.019. S. 40 cc. in 4 hours. Intravenous urography showed bilateral polycystic kidney. The patient was treated with sulphadiazine and was discharged free from symptoms on 10. 3. 1938. During the following years she had an intermittent dull pain in the right side of the abdomen. She was taken ill again on 15. 8. 1940 with fever, shivering, vomiting and abdominal pain in the right side. She was readmitted to Maria Hospital on 18. 8. 1940 with a temperature of 39.5° C. A large, smooth, resilient tumour was then palpable in the right renal region, extending considerably below the umbilical plane. The sediment contained 10—15 leucocytes per visual field, as well as coli bacteria. N. P. N. 42 mg%. Hgl. 68 % R. B. C. 3,900,000. Under medical treatment the pain and fever regressed. The patient was oper-

<sup>1</sup> »Varicocide» is a proprietary sclerosing substance used in the treatment of varicosis.



ated on 3. 9. 1940<sup>1</sup> (BRANDBERG). A typical polycystic kidney with big cysts in the upper part of the right kidney and small cysts in the lower part was found. Relatively much normal parenchyma remained. The accessible cysts were opened and the walls excised. The remaining walls of the cysts were etched with "varicocide". The postoperative course was uneventful. The patient was discharged on 28. 9. 1940 with a normal blood picture. N. P. N. 37 mg%. E. S. R. 8 mm/hour. Once a year, after the operation, the patient had a period of fever and pain over the right kidney. The symptoms regress in a week and cause her very little anxiety. The physicians she has consulted have been more dubious and have once remitted her to hospital for observation. At the follow-up examination on 31. 3. 1947, the kidneys were very enlarged and easily palpable. The right kidney was still larger than the left. The urine was still infected, the sediment containing numerous leucocytes and coli bacteria. N. P. N. 38 mg%. Specific gravity 1.011. B. P. 230/115. Traces of albuminuria.

*Case 3.* E. V. E., a woman, b. 1901. No history of previous illness. Pregnancy and normal delivery in 1923. The patient was taken acutely ill on 20. 3. 1946 with pain resembling renal colic on the left side, haematuria and fever. She was admitted to a nursing home and was treated there for a week. During this time the temperature returned to normal and the urine became clear. N. P. N. 50 mg%. E. S. R. 58 mm/hour. Hgl. 56 %. On intravenous urography the left kidney showed no excretion and its outlines were not clearly seen. On the right side a somewhat large pelvis was seen, with very little deformity. The patient was admitted to Södersjukhuset on 8. 4. 1946. The renal regions were normal on palpation. N. P. N. 30 mg%. E. S. R. 29 mm/hour. The sediment contained approximately ten leucocytes per visual field. The pyelogram showed on the left side an irregular plum-sized cavity in the lower part of the kidney, which was enlarged, and displaced the ureter medially. Repeated urography still showed no excretion from the left kidney. Operation on 29. 4. 1946 (BRANDBERG). The kidney showed general cystic degeneration. The outer cyst walls of all accessible cysts were excised. The kidney was then flaccid and considerably shrunk. The remaining walls of the cysts were painted with "varicocide". The wound was sutured with a thin tube to the renal region. The postoperative course was uneventful, and the urine was thereafter normal. Follow-up examination on 31. 3. 1947. The patient had symptoms of hypertension with headache and vertigo. B. P. 210/130. She has had no symptoms from the kidneys or the bladder since the operation. The kidneys were still not palpable. N. P. N. 43 mg%. The sediment contained numerous leucocytes and coli bacteria. On intravenous urography there was very little excretion from the left kidney, which was smaller than before the operation. A certain improvement has thus taken place. On the right side there was a slight deformity, showing evidence of incipient cystic degeneration.

*Conclusions:* The conservative operation in polycystic kidney is an intervention which is accompanied by little risk and only

slight inconvenience to the patient. The kidney — formerly distended with obvious signs of the pressure on the functioning parenchyma and with circulatory disturbances in the form of cyanosis and vascular compression — assumes a nearly normal shape, size and consistency. To the surgeon, the operation must, therefore, appear rational. The further course shows, however, that the development of the disease in our patients has only been influenced temporarily by the intervention. It is thus advisable to confine the operation to such cases in which rapid enlargement of the kidney, threatening increase of the blood-pressure, or rapid deterioration of the renal function exist. In such cases, the amelioration following the operation is sometimes considerable and lasting.

Our cases show that attacks of pain, fever and moderate haematuria can regress spontaneously under medical treatment with anodynes and antispasmodics. During the acute stage, the operation should only be performed if there are signs of abscess formation, dangerous haemorrhage, or uraemia.

Finally, our cases show that the condition of the kidneys and the result of the operation must be judged on the basis of urological examination with examination of the urine, renal function tests, intravenous urography and determination of the blood pressure. The subjective symptoms of the patient are, in this respect, only of secondary importance.

### Summary.

The author gives a short description of polycystic kidney disease. The disease is a malformation, often associated with other dysontogenetic changes. The contents of the cysts are formed through filtration into a still active glomerulo-tubular system. Patients are sometimes admitted to surgical departments on account of complications to polycystic kidney, such as pain, fever, haematuria, calculi. The concentration capacity of the kidneys is in such cases often maintained, and the prognosis may then be relatively good. Uraemia in advanced polycystic kidney disease is characterized by the unaltered general condition of the patient. Hypertension and retinopathy are not necessarily present. Hypochromic anaemia may exist. Palpation of the kidneys is the decisive factor in establishing the diagnosis. In early cases, the diagnosis is established only after roentgenological examination.

Attacks of pain and fever may regress during treatment with anodynes and antispasmodics. ROVSING's operation should be performed: (1) in perinephritis and infected cysts, (2) in large haemorrhages, (3) in threatening uraemia, (4) in rapid deterioration of kidney function and (5) in rapidly increasing hypertension. The immediate result of the operation may be very satisfactory (see Case 1). The development of the disease is, however, as a rule only temporarily influenced by the operation (cases 2 and 3). The state of the patients at the follow-up examination must be judged from the results of the examination, not from the subjective symptoms.

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## The Significance of the So-Called Reaction of Decompression in Chronic Retention of Urine.

By  
ARNE HOMB.

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### Introduction.

In a hospital department which chiefly receives patients from rural districts a large number of the patients admitted for hypertrophy of the prostate will have had the disease for a long time and will have considerable retention of urine. The first treatment is here very important and will often be of decisive significance for the subsequent course of the illness.

In case of chronic retention of urine the increased pressure in the urinary passages will have a retroactive effect on the kidneys, whose functioning will gradually be impaired. This finds expression first and foremost in a reduction of the power of concentration. The changes in the renal function, however, will long remain to some extent reversible, and through drainage of the bladder even a severe affection of the kidneys may be relieved.

By what means can permanent retention of urine be remedied?

*Sudden* evacuation has long been regarded as an erroneous procedure, and a number of leading urologists (including YOUNG, THOMPSON-WALKER, PRÆTORIUS) have warned against such a mode of emptying the bladder on account of the *reactions of decompression* that may be induced. These may produce symptoms from the bladder in the form of hemorrhage, from the kidneys in the form of further impairment of their function, with anuria and uremia, from the circulation as a fall in blood pressure and from the central nervous system there may come signs of irritability and obscured sensorium.

In a series of 150 patients with over 400 cc. of residual urine, all of whom had an indwelling catheter on admission and received

copious supply of liquids, YOUNG found a reaction of one or other form in 90 per cent of the patients. In most cases, however, the reaction was only slight.

Hemorrhage in the bladder is regarded as the least dangerous form of reaction, and in most cases it occurs only as petechiae in the mucous membrane. YOUNG, however, also saw cases with profuse, persistent bleeding. RUBRITIUS, on the contrary, has never noted any *perilous* hemorrhage and he believes that bleeding cannot be avoided even by slow emptying.

More formidable is the reaction from the kidneys. YOUNG found in almost all cases proteins and red blood corpuscles, sometimes also casts, in the urine a few hours after the catheter had been inserted. He not infrequently saw that patients who had normal blood findings before catheterisation shortly afterwards showed N-retention and symptoms of uremia. He believed, however, that in many cases infection played an important rôle in the impairment of the renal function, together with the evacuation of the bladder.

PRÆTORIUS states that in ischuria paradoxa a sudden emptying of the bladder with subsequent permanent drainage will in nearly all cases lead to "almost immediate death" as a result of shock. In other cases of great and medium degrees of retention the reaction to evacuation will manifest itself chiefly by characteristic changes in the diuresis: "Positive paradoxal reaction" with oliguria or anuria and threatening general symptoms in case of severe irreparable renal lesion, "positive correct reaction" with diuresis increasing to polyuria in conjunction to drainage in case of a considerable, but reparable renal lesion, and "negative reaction" without any great changes in the diuresis in case of slightly affected kidneys.

According to YOUNG, reaction from the circulation is more rare than reaction from the kidneys, but in about half of his patients he noted a gradual fall in blood pressure in the course of the first days, seldom more than "20 points". Five patients showed a greater reaction, with shocklike conditions, three of whom had a blood pressure below 60. There is, however, no complete agreement of views respecting the blood pressure reactions in case of urine retention and evacuation of the bladder. While some authors state that increased blood pressure is frequently seen in case of great retention, others assert that increase of blood pressure is not more often found in patients with urine retention than in

healthy individuals of corresponding age. And whereas some authors regularly note a fall of blood pressure in the first days during drainage of the bladder (ELFVING), others find that the pressure is in most cases fairly stationary (NICOLAYSEN).

For fear of reactions the emptying of the bladder is therefore in most hospitals carried out slowly and successively.

At a meeting of the Scandinavian Surgical Association in 1919 INGEBRIGTSEN dealt with the emptying of the bladder in prostaties with retention. In some patients with uremia who were treated by catheterisation the concentration of serum urea increased, and they died in uremic state. INGEBRIGTSEN afterwards proceeded to perform cystostomy immediately after admission in case of prostatic patients with retention and at the same time provided for an abundant convey of water, and he found that the concentration of urea declined. Therefore in Surgical Department B of the Oslo University Clinic cystostomy has been regarded as the best form for bladder drainage in these cases. We attain secure relief of pressure and avoid the irritation of the urethra that is caused by use of an indwelling catheter.

Likewise in some other hospitals no regard is paid to the reaction following decompression, but they consistently adopt a rapid and complete drainage of the bladder, as it is believed that the reactions are not more frequent when the latter mode of procedure is employed and that they are so rare and so slight that they play no important rôle.

From the Krankenhaus der Stadt Wien BRECHER and CHWALLA in 1931 submitted a material of 1,250 patients, of whom the last 300 were treated by rapid and complete drainage (chiefly by use of indwelling catheter), while the previous cases were treated by successive emptying of the bladder. Evacuation reactions were not more frequently observed in the latter than in the former group. No cases of anuria or uremia after the evacuation were noted.

These authors maintain: *Dangerous* becomes evacuation of a chronically distended bladder only when the kidneys have not a sufficient quantity of liquid at disposal, since the actual reaction of the kidneys to evacuation of the bladder is polyuria. They found, it is true, that some of their patients reacted with oliguria, as described by PRÆTORIUS, but this appeared only in the first or at most in the two first days, whereupon it changed over to polyuria. The chief danger in urine retention is *infection*.

In case of gradual emptying of the bladder (whereby there remains a rather large quantity of urine, in which microbes may multiply) infection can hardly be avoided, even with good asepsis. The resistance in the distended mucous membrane is reduced. Internal use of urine antiseptics is of little value in such cases. Uremia after the evacuation is in most cases chiefly due to pyelonephritis. BRECHER and CHWALLA regard complete emptying of the bladder as being the best means for counteracting the ascending infection.

(BRECHER holds also out that of regard to the pressure conditions in the bladder an immediate complete evacuation is advantageous. On partial emptying of a distended bladder we get increased pressure therein, seeing that through reduction of its volume and thereby of its superficial area we get a larger number of contractile elements per unit of surface. Thus the kidneys will have an increased pressure to work against. That this is actually the case he proves by manometry of the bladder. YOUNG avoids this difficulty by use of his apparatus, whereby the bladder is emptied slowly and automatically with control inspection of the pressure therein, and after the introduction of this method he has noted a striking improvement in the results.)

GÜTTGEMANN in 1931 submitted the results of an investigation in Bonn, where rapid and complete evacuation of the bladder had also been adopted, without any increase in the frequency and degree of the reactions thereto being observed.

Likewise in these hospitals the drainage of the bladder is in the first instance effected by indwelling catheter, and cystostomy is usually performed at a later point of time. Only in exceptional cases is cystostomy done immediately as an emergency operation when catheterisation cannot be accomplished.

### Own material.

In Surgical Dept. B of Oslo University Clinic it has for many years been usual to perform cystostomy in the course of the first couple of days on patients who are suffering from great chronic retention of urine and have not been treated before admission. The catheter is used only to measure the residual urine on admission and perhaps to empty the bladder once or twice during the observation period. *The patients are copiously supplied with liquids and are put on a diet poor in nitrogen.*



As it may be of interest to examine the reactions of decompression in these patients. I have gone through the cases of prostate hypertrophy treated in the department in the years 1930—1945. Altogether 150 patients have been under treatment. Observation patients whose symptoms were so mild that treatment was not necessary have not been included in the survey. The treatment adopted in the department has principally been suprapubic prostatectomy in two stages.

The material is divided into the following groups:

*A.* Patients cystostomized without previous catheterisation. Serum urea on admission  $\geq 50$  mg. % and residual urine  $\geq 400$  cc. In all 58 patients. (Urea determined by the bromine hydroxyde method in Yvons tube.)

It is this group that is of greatest interest in the study of the reactions of decompression.

*B.* Patients treated in the same way, but with serum urea  $< 50$  mg. %, 42 patients in all.

34 had residual urine  $\leq 400$  cc. Only 8 had residual urine  $\geq 500$  cc.

*C.* Patients cystostomized after previous catheterisation treatment.

53 patients in all. Of these 34 had been catheterized during several days, often weeks, *before* admission. A smaller number (19) were catheterized in the hospital. (The reason for this has often been the desire for closer examination by cystoscopy and urography.)

*D.* Patients insufficiently examined with respect to serum urea and residual urine, 7 in all.

*Table 1* gives a survey of the number of patients who underwent cystostomy or prostatectomy and the number of deaths after each of these operations in the different groups.

Table 1.

	Cystostomy		Prostatectomy	
	Operated	Deaths	Operated	Deaths
A .....	58	2	47	3
B .....	42	2	33	2
C .....	53	7	47	3
D .....	7	1	5	0
Total	160	12	132	8

The mortality after cystostomy is  $7\frac{1}{2}$  per cent and after prostatectomy 6 per cent. 82 per cent of the cystostomized patients also underwent prostatectomy.

*Group A.*

Table 2 shows the distribution of the 58 patients in Group A with respect to serum urea and to residual urine.

Table 2.

	Serum urea. Mg. %	50—59	60—79	80—99	100— 119	120— 149	150— 199	200— 249	250— 299	≥300	
<i>Residual urine.</i>	400 cc.	1	2	3							6
	500 cc.	2	4	1	1	2				1	11
	600—700 cc.	1	3		1	2			1		8
	800—900 cc.	1	1	2	1	1					6
	1000—1400 cc.	3	7	2	2	1	5	1			21
	1500—1900 cc.				1	1	1				3
	≥2000 cc.						2	1			3
	Number of pa- tients .....	8	17	8	6	7	8	2	1	1	58

17 of these patients had ischuria paradoxa. 34 (over  $\frac{2}{3}$ rd) had serum urea above 70 mg. %.

After the cystostomy determinations of serum urea and measurement of the diuresis have been regularly made. On the other hand, the blood pressure has not been recorded so frequently as to render the material suitable for investigation of this side of the reaction of decompression. No cases of circulatory collapse have been observed.

In Table 3 the material is arranged in groups according to the serum urea content previous to cystostomy. It gives a survey of the values to which the urea fell after cystostomy, how many patients showed a temporary rise in the urea and the number of deaths after cystostomy. Further is entered the number of patients in each group who underwent prostatectomy.

In all cases, except two, there came a decline in serum urea after the cystostomy. In one of the two exceptions the serum urea was 55 mg. % both before and after the operation. The other case was a greatly enfeebled patient who was stuporous on admission, with a serum urea of 300 mg. % and considerable pyuria. He died on the second day after the cystostomy. The diuresis

Table 3.

Serum urea previous to cystostomy	Cystostomy Operated on	Serum Urea reduced to below 40 mg. % Number of pat.	Serum Urea reduced to be- tween 40 and 50 mg. %	Serum Urea reduced to be- tween 55 and 75 mg. %	Serum Urea temporary rise Number of pat.	Deaths after cystostomy	Prostactomy Operated on	Deaths after prostactomy
50—59.....	8	7		(1)			7	
60—79.....	17	12	5				15	2
80—99.....	8	6	2		1		7	1
100—119.....	6	3	1	2	1		5	
120—149.....	7	5	2		1		4	
150—199.....	8	5	3		2		7	
200—249.....	2		2				2	
250—299.....	1					1		
300.....	1					1		
	58	38	15	3	5	2	47	3

on the first day was 1,500 cc. Autopsy revealed a severe pyelonephritis.

Besides this patient, another died of pneumonia on the 16th day after cystostomy. Serum urea was reduced from 250 to 100 mg. %.

In five patients the decrease of the serum urea was not satisfactory. All of them were infected before admission and had a considerable pyuria.

The large quantities of liquid which it is desirable to supply in cases of uremia impose certain demands upon the cardio-vascular system, and in one of these patients heart failure with edema probably contributed to prevent the serum urea from falling to a satisfactory level.

Five patients had a temporary increase in serum urea. In three of these the rise was of slight extent and occurred in the first week after cystostomy, when the serum urea had already decreased considerably. In the fourth case the increase was more pronounced and came in the third week after the operation, in conjunction to a period of fever.

An actual reaction of decompression occurred only in one case, in a patient who on admission had a serum urea content of 156 mg. %. After cystostomy it increased to 264, at a time when he was stuporous for 24 hours, but it gradually declined to 44 mg. %.

This patient had doubtless been given too little fluids, the diuresis being only 1,000 to 1,500 cc.

All these patients with a temporary increase in serum urea afterwards showed satisfactory renal function and underwent prostatectomy without complications.

As control-examinations of serum urea on the 1st and 2nd day after the cystostomy was made only on one half of the cases, reservation must be made for the possibility of slight rises on these days. Among the cases in which such examinations were made, however, only one patient showed increase so early.

*Reaction of decompression with regard to diuresis.* Of the 58 patients in Group A 22 had polyuria from the day of operation (diuresis above 2,000 cc). In 12 cases there came no perceptible reaction, the diuresis remaining more or less stationary between 1,000 and 1,500 cc.

Altogether 24 patients either had oliguria after the cystostomy (diuresis below 1,000 cc. in 18 cases) or else had a distinct fall in the diuresis, even if it did not come under 1,000 cc. (6 patients). Meanwhile, over one half of the patients (14) had low diuresis only on the day of operation, while already on the following day it had risen to above 1,000 cc. and in a further 7 cases the fall in diuresis was noted only on the operation day and the following day. No protracted oliguria has been observed.

In some cases the supply of liquids was deficient, as the patients drank very little and were not given liquids parenterally, but transient oliguria was also noted in patients who received copious supplies of liquid.

A slight admixture of blood in the urine in the first days after the cystostomy was commonly noted. This is a thing we also see in cases of cystostomy where the bladder had not been distended beforehand, and it is reasonable to suppose that the bleeding originates mainly from the incision in the bladder and is not due to the evacuation. But the possibility of bleeding from the kidneys cannot be excluded, and we have no means of control in this respect. No bleeding of importance was observed in conjunction either to catheterisation or to cystostomy.

In this group prostatectomy was performed on 27 patients, three of whom died (1 from pyemia, 1 from pneumonia and 1 from ileus due to adhesion). In 7 cases prostatectomy was found inadvisable, owing in 2 cases to suspicion of cancer, in 1 to diabetes and vitium cordis, in 2 to advanced age and bad general con-

dition, in 1 to severe pyuria and unsatisfactory renal function with isosthenuria and in 1 to severe dermatitis. Four patients were unwilling to undergo a radical operation and returned home with a Pezzer catheter.

*Group B.* As the 42 patients in this group had a serum urea under 50 mg. % and most of them residual urine  $\leq 400$  cc. no evacuation reactions were expected, and more or less frequent examinations of  $\text{Ur}^+$  were made in only one fourth of the cases. In some we find a slight, but only transient increase in serum urea, and in all cases the content falls to below 40 mg. %.

As regards diuresis we do not find in this group such pronounced reaction as in the preceding group. Polyuria appeared in only five cases, in three of which the residual urine amounted to between 900 and 1,300 cc. Of the other patients about one half had a diuresis of between 1,000 and 1,500 cc. while in the remaining cases there was seen transient oliguria in the first couple of days after the operation, without subsequent polyuria.

Two patients died after cystostomy (1 from pulmonary embolism, 1 from bronchopneumonia). 33 patients afterwards underwent prostatectomy, and of these two died (pulmonary embolism, peritonitis).

*Group C.* 53 patients, cystostomized after previous catheterisation. As most of the patients were catheter-treated at home and serum urea and residual urine content before catheterisation began are therefore unknown as regards the majority, the group is not suited to throw light on the reactions of decompression. (Some of these were cases of acute retention, where a complete emptying of the bladder is not usually regarded as dangerous.)

Serum urea < 50 mg. % on admission .....	24	
Of these there died after cystostomy.....		1
Urea $\leq 50$ mg. % on admission .....	29	
Fall in urea during catheterisation to below 50		
mg. % in .....		17
Of these there died .....		3
Cystostomized with urea > 50 mg. % .....	12	
Of these there died .....		3

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In all: Cystostomized 53. Died 7.

The causes of death were: In 2 cases pulmonary embolism, in 1 case bronchopneumonia. One patient died from a dissecting

aortic aneurysm three weeks after cystostomy (Serum urea had fallen from 80 to 45). One very feeble patient, aged 81 years, died from a periprostatic abscess (occasioned by a *via falsa* in catheterisation?). Two died of severe pyelonephritis and pyonephrosis respectively in combination with uremia. Both of these had severe pyuria and increased serum urea when admitted to hospital. The urea rose during catheterisation in the hospital, but fell in one patient after cystostomy from 240 to 110 mg. %.

What is then the significance of an increased serum urea on admission as regards subsequent prostatectomy?

Our material has a large percentage of uremic patients, as compared with what has been found in other hospitals. At the meeting of the Scandinavian Surgical Association on 1947, for example, GIERTZ submitted a material from the Caroline Hospital consisting of 717 patients, of whom only 1 per cent had non-protein nitrogen exceeding 60 mg. % and in STEIN F. HOLST's material 3 per cent of the prostatectomized patients had serum urea above 75 mg. %.

Of our 160 patients 132 (82 per cent) had undergone prostatectomy. The ratio between cystostomized and prostatectomized patients is about the same in all groups. In a large proportion of them the serum urea was found to be considerably increased on admission: In 57 cases (42 per cent) the serum urea was over 60 mg. % and in 36 cases (27 per cent) it was over 75 mg. %.

Previous to the prostatectomy serum urea had fallen to 50 mg. % or lower, but the power of concentration was to a large extent reduced.

Eight patients died after prostatectomy (6 per cent), but none of the deaths were due to renal insufficiency.

### Summary.

After a brief account of the decompression reactions observed in consequence of emptying of the bladder in cases of great chronic retention of urine the author reports a material of 160 patients with hypertrophy of prostate examined with a view to such reactions. 58 patients with great chronic retention of urine, most of whom had considerably increased serum urea, were treated by cystostomy in the course of the first couple of days after admission. The bladder was emptied completely with a catheter im-

mediately on admission, the method of gradual decompression not being adopted. The cystostomy was followed by copious diuresis and decline of the serum urea, except in two cases. Only in one case was there observed a marked reaction of decompression with a considerable rise in the serum urea. This reaction was transient and without injurious effects. From the experiences from this material it seems that rapid decompression of the chronic distended bladder is not dangerous. The condition is, however, that the patients are copiously supplied with fluids and kept on a diet poor in nitrogen.

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## Intussusception as a Complication after Appendectomy.

Report of a Case.

By

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Intussusception is a common occurrence in children. LAVESON, by studying different statistics, found an incidence of 57.9 per cent in infants, 26.3 per cent in children, and 15.8 per cent in adults. In adults a definite cause can usually be assigned. ELIOT and CORSCADEN have studied 300 cases in adults where they found 60 cases caused by benign tumor, 40 by malign tumor, several caused by ulcers with different etiology, and, finally, some cases caused by Meckel's diverticulum. According to the literature, primary intussusception of the appendix is not a rare occurrence. F. CHRISTOPHER finds that up till 1939, 80 cases have been reported, and SKARBY, in 1941, reports on one personal case and discusses 26 cases described by SZENES. These intussusceptions may cause a further invagination of adjacent portions of the intestine. On the contrary, intussusception as a complication after appendectomy appears to be very rare. BRODERSEN published one case in 1939, and he did not find similar cases described in the literature available. In the work of NYBORG he refers cases, described by SWARTS and SCHARF, where the cause might have been the invaginated stump of the appendix. Except for these three cases, the author has not found the condition mentioned as a complication after appendectomy in the to him available literature. One case of ileocecal intussusception, recorded by MILROY, developed three weeks after an appendectomy and during an enthelmintic cure,



and cannot be regarded as a complication caused by the appendectomy.

Our case differs from the three previously mentioned, as the appendical stump was not invaginated, but just ligated.

### Case Report.

K. L., male, aged 21. Reg. no. 4055/46/47.

Previously pneumonia several times. Discharged from the hospital last time on November 28th, 1946, after a cure for *ulcus duodeni* and operative treatment of a hypogastric hernia. This time he was admitted to the hospital with symptoms of an acute appendicitis, having felt well since the operation till the day before the admission. Poor appetite, *functiones naturales* otherwise normal.

*Physical examination, December 7th, 1946:* Temperature 38.1 degrees (C), pulse 100, regular. Respiratory and cardiovascular systems normal. There was a distinct tenderness and rebound tenderness just above McBurney's point. The urine was normal. Just after the admission *appendectomy* was performed under spinal anesthesia (parocain 0.10 Gm. + butylocain 0.005 Gm.). Criss-cross incision. The peritoneal cavity contains some yellowish fluid. The appendix is freed and the stump treated *ad mod.* Seelig (*i.e.*, ligation of the appendix with silk or linen, the stump corroded with carbolic acid and dropped without being invaginated). The removed appendix was 10 cm. long, thickened and congested. The mucous membrane was edematous with a slight gangrenous tip. The lumen was filled with pus.

No complications occurred during the consecutive days. He was afebrile, felt well, and got up the third day. The evening temperature was then 36.9 degrees. He did not feel quite well at bedtime, but was otherwise not affected and went to sleep. He awoke the same night at 3 o'clock from intense, intermittent pains in the abdomen. The pains continued also during the following morning. At noon-time he had four vomitings. Later on the pains were not so intense. The morning temperature was 37.4, the evening temperature 39.5 degrees. The condition was diagnosed as an intestinal infection. On the evening round the physician in charge thought he felt a resistance below the umbilicus. During the evening the pains increased, and about 11 o'clock p.m. he passed a bloody, slimy stool. On abdominal auscultation tinkling ileus-sounds could be heard. A *plain roentgenogram* revealed some gas in the intestine, and two fluid levels in an intestinal loop in the middle of the abdomen. A *barium enema* passed easily up to the right half of the transverse colon, where it stopped. Finally it forced its way to the right flexure, but then it was impossible to get the contrast any further. Roentgenograms of this region showed a typical picture of intussusception.

About 22 hours after the onset of the pains *laparotomy with ileocecal resection and ileotransversostomy* was performed under spinal anesthesia (parocain 0.10 Gm. + butylocain 0.005 Gm.) and gas-ether narcosis.

Midline incision. On opening the peritoneal cavity loops of distended small intestine are seen. Ileum is seen to disappear into the upper part of the ascending colon like in a cuff. Reposition is easy as far as past the ileocecal part, but further reposition is difficult. Cecum is freed, but the pole of the cecum is still invaginated at two places between the taeniae. These invaginations are difficult to reposit, but one finally succeeds, by pulling and at the same time pushing "through" the upper part of the bowel. But even while holding the cecum in the hand, invagination repeatedly occurred at the same places, in spite of repeated repositions.

The wall of the cecum was much thickened and stiff anteriorly and laterally. Serosa was bluish-red and did not have the normal glossy appearance. Corresponding to the site of the appendix, the wall was still more thickened, stiff and congested. The stump could not be seen. On manipulating the organs there came a small perforation at this place, and some gas escaped. Cecum as a whole was very mobile. A few centimeters of the distal part of the ileum was somewhat thickened, and there was a slight distension orally. Otherwise, the small intestine had a normal appearance. An ileocecal resection was performed, the part 15 cm above the ileocecal valve to the middle of the ascending colon being removed, and passage established by an ileotransversostomy. Except for a wound infection and an abdominal infiltrate on the right side, the postoperative course was uneventful. At the time of discharge from the hospital, on January 1st, 1947, the patient was completely restituted.

### Comment.

A complication like that mentioned above is a very rare occurrence. When confronted with such a case, it may easily be misinterpreted. The first thing one naturally will think of is an ileus caused by a local peritonitis, or, as in our case, an infectious enteritis, especially on account of the rise of temperature and the diarrhea. However, the rise of temperature came late and was probably due to changes in the intestine caused by the ileus and not by an intestinal infection. On account of the intense pains, which were of ileus type, one should have understood that ileus had developed. First when the slimy, bloody stool was observed, intussusception was diagnosed. If this condition is considered first when marked, intensive pains develop so shortly after the operation, it should not be difficult to diagnose the condition when the available diagnostic means are used. An early diagnosis in such a case is most important, as the treatment differs from that of the usual, early postoperative complications.

As to the cause, NYBORG has reported two cases where the in-

vaginated stump of the appendix has behaved like a tumor and has been seized by the peristalsis. BRODERSEN explains his case in the same way, even if he states that the invagination had been quite superficial. In our case, the *stump was not invaginated*, and even if the portion was considerably thickened, it did not impose as a tumor. A number of theories have been postulated as to the cause — endogenous, such as a very mobile section of the gut, or a hypertrophic lymphatic apparatus, and exogenous exciting causes, such as diarrhea. Our patient had diarrhea, but it developed after the onset of the pains, and must be regarded as caused by, and not causing the intussusception. NYBORG emphasizes this circumstance. LAVESSON holds that the intussusception in children usually starts at the cecal pole, thus causing an invagination coecalis, coecocolica, or coeco-ileocolica as a further stage where also the ileum is involved. The cause should be that stagnation of intestinal contents readily may take place at the bottom of the cecum, causing a thickening of the wall between the haustra. A thickened, edematous portion of the cecum should thus be the starting-point of the intussusception.

The operational findings in our case correspond to this theory, the wall of the cecum being much thickened and edematous, and the repeated invaginations which were seen at this place. Against this it may be said that the complication would be expected to occur more frequently after an appendicitis. The explanation to this might be that during the time when the thickening and the edema are most marked, the postoperative atony of the gut will be present. However, several other theories exist, where other factors are considered.

A general conclusion cannot be drawn from this case, but it demonstrates that in this instance the exciting cause and the starting-point are a thickened, rigid part of the wall of a mobile cecum.

### Summary.

In a male, aged 21, a ceco-ileocolical intussusception develops four days after an appendectomy in an ordinary case of acute appendicitis. The appendical stump was "ligated and dropped". A mobile cecum was found, and a thickening of its distal part was found to be the exciting cause and the starting-point of the intussusception. Ileocecal resection and ileotransversostomy had to be

performed. The author has found this complication described only three times in the literature available, but in these cases the stump had been invaginated. The incidence and the causation are briefly discussed.

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## Transplantation of the Levator Muscles in the Repair of Complete Tear and Rectovaginal Fistula.

By

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An operation of a recidivating rectovaginal fistula, or of a recidivating complete tear of the perineum, is not rarely followed by recurrences in spite of colostomy prior to the surgical intervention. Sometimes patients may have been operated upon four to five times without healing. Occasionally this is due to infection. The process will, however, frequently begin with an aseptic necrosis, owing to an unsatisfactory supply of blood to the cicatricial tissue which invariably surrounds a recidivating fistula. This applies particularly to fistulas appearing after radiological treatment.

In such a condition the principle of operation is to remove, as completely as possible, the old cicatricial tissue, and then to cover the intestinal suture with wellnourished tissue from adjacent parts after having sutured the rectal wall and the sphincter. Several methods are available for this procedure, for instance, pulling down a fold of the above situated part of the rectum (FRIGYESI 1942), interposing the uterus in the rectovaginal septum (AMREICH 1941) or using the bulbocavernosus muscle with surrounding adipose tissue (MARTIUS 1941). Usually, the two levators (pubococcygeus muscles) are sewn together in the mid-line. However, this invariably causes a certain tension and the musculature will not keep properly close to the intestinal suture.

On the other hand, the surgical technique elaborated by the present author with regard to the repair of the pelvic floor in

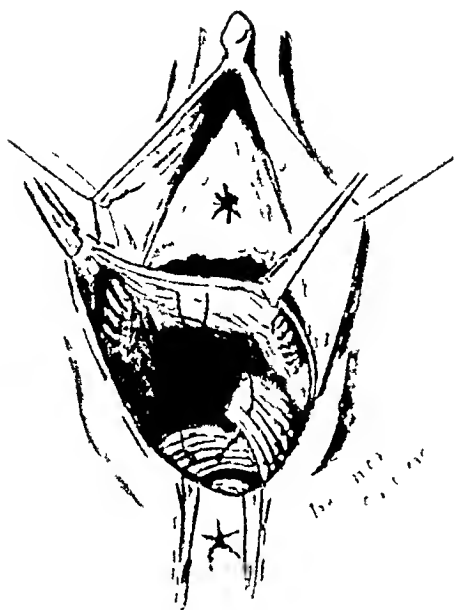


Fig. 1.

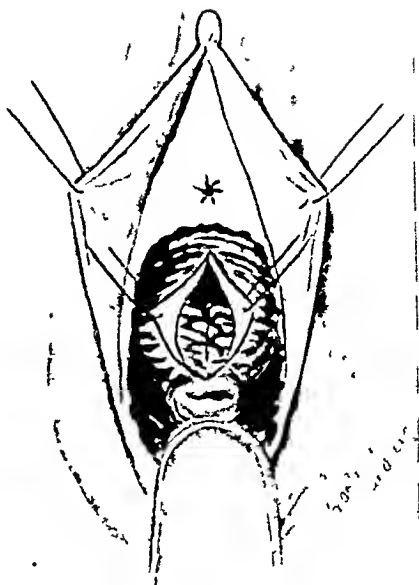


Fig. 2.

cases of stress incontinence and at vesicovaginal fistulas involves a division into two approximately equal parts of the levators (pubococcygeus muscles) each being used separately at the plastic surgery (INGELMAN-SUNDBERG 1947). In spite of this dissection no atrophy will appear on account of the fact that the nutrition of the vessels and the nerves remains satisfactory in either muscular part. When the same procedure is adopted in the case of rectovaginal fistulas and complete tears of the perineum, the intestinal suture being covered by the posterior portions of the levators after their division, this can be performed without causing any tension whatever in the levator suture. The covering may even comprise two layers close to the intestinal wall by placing the posterior levator portions one above the other (Fig. 1). For the purpose of regaining some fixation of the anterior levator portions and again permitting them to perform their supporting function in the pelvic floor, they are sutured in the midline under the bladder neck as well as fastened in the cervix so as to counteract the occurrence of a future prolapse. This is carried out from an incision in the anterior vaginal wall as seen in Fig. 2. By means of a clamp, a canal is dissected along both lateral walls of the vagina. The free muscle ends are then brought up through this

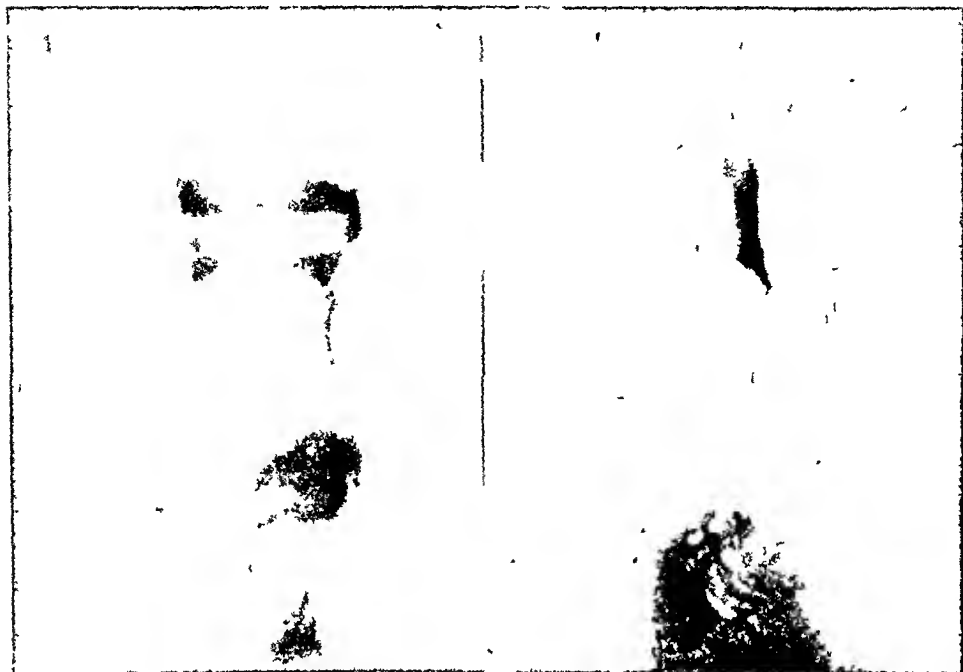


Fig. 3.

Fig. 4.

canal to the incision in the anterior vaginal wall. They are then sewn together mutually and with the cervix, with sutures of silk or wire of stainless steel. In other respects, the particular technique adopted is of minor significance in this connection. A small fistula is invaginated into the rectum according to DAVID. If the fistula is a big one or if there is a complete tear of the perineum, total colpoperineorrhaphy with an intestinal suture, is performed.

The present author has been in a position to apply this technique in the case of a complete rupture of the perineum where two previous operations by means of the ordinary methods had failed to produce any result.

Rec. 460/47. This case concerned a woman, aged 33, who had borne four children. In connection with the last parturition, which was in breech presentation, she sustained a complete tear of the perineum which was operated upon twice without healing in another hospital (Fig. 3). After preoperative treatment with stilbestrol she was operated upon acc. PHANEUF's technique, as well as with the plastic surgery involving the levators described above. The vagina was sponged with gauze powdered with micro-crystalline sulfathiazole for forty-eight hours. Primary healing occurred, and the patient was discharged with complete continence a good fortnight after the operation (fig. 4).

### Summary.

A new form of plastic surgery with the use of the levators is described and recommended in cases of recidivating rectovaginal fistulas and at complete tears of the perineum. The levators (pubococcygeal muscles) are divided approximately in the middle and the posterior portions sewn in two layers over the intestinal suture. The anterior muscular parts are stitched together under the bladder neck and fixed to the cervix in order to counteract a possible later uterine prolapse. The advantages of this method are that the levator suture can take place without any tension whatever and, secondly, that a very satisfactory covering of the intestinal suture is obtained. Patients with rectovaginal fistulas or complete tears often also have an injured pelvic floor owing to a difficult parturition with a liability to a uterus prolapse and prolapse of the bladder neck with stress incontinence. This plastic surgery offers an effective strengthening of the pelvic floor, thus precluding the occurrence of such diseases.

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## Two Cases of Affection of the Vascular System Treated by Bilateral Suprarenal Medullectomy.

By

DAVID H. BØGGILD.

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Two cases of affection of the vascular system are here reported in which sympathetic ganglionectomy showed insufficient effects, while bilateral suprarenal medullectomy produced a favourable result.

As is well known, total epinephrectomy, if no greatly aberrant cortical elements are present, is irreconcilable with the normal continuation of life.

That the cortex is a vitally necessary part of the suprarenal glands was first demonstrated by BIEDL (1) on Chondropterygians, whose interrenal bodies correspond to the suprarenal cortex of higher animals. The correctness of BIEDL's conclusions has often been confirmed on mammals. The medulla, the principal source of the epinephrine production, on the other hand, is not vitally necessary. In several previous publications I have shown (2) that the viability of rats and dogs was not affected after I had performed medullectomy on them. Later serial microscopy revealed that the entire suprarenal medulla had been removed from the rats, while only insignificant remnants remained in the dogs. Animals thus operated on showed normal fasting blood sugar and possessed their entire fighting capacity and vitality. — The general experience with endocrine glands suggests that the greater part of a glandular element has to be removed to produce any effect; we may recall *e. g.* the experience from strumectomy, or experimental aponeurotic diabetes; in the latter case more than

9/10 of the insular apparatus must be removed before diabetes sets in. Hence it seems illogical to the author that *c. g.* OPPEL (3) and LERICHE (4) attempt to obtain a therapeutic effect by removing a suprarenal gland. It is true that removal of the cortex from one of the suprarenal glands is not injurious, if the other gland is present, particularly since cortical tissue, if enough remains to preserve life, has the power of hypertrophying. But it is superfluous, and removal of the medulla of one suprarenal gland with retention of the other cannot, after what was shown above, be expected to produce any great effect, apart from the fact that chromaffin tissue, whether left in suprarenal glands — or in paraganglia —, as far as the author knows, does not hypertrophy. It may possibly be due to the chromaffin tissue in the paraganglia that the entire suprarenal medulla can be dispensed with.

OPPEL (3) tried whether the removal of a suprarenal gland would produce any effect in Raynaud's disease; his reports do not seem convincing and his method is abandoned. DURANTE (5) ventilates bilateral medullectomy in Raynaud's gangrene and obliterating endarteritis; in three cases he performed medullectomy of one suprarenal gland and in two of them denervated the other; he takes an optimistic view of the effect, even of isolated unilateral medullectomy; but his observation periods seem short.

LERICHE (4) to a certain extent uses unilateral extirpation of a suprarenal gland as a supplement to resections of the sympathetic in arterial hypertension, though he does not seem to attach decisive importance to it.

### Own Cases.

*Case I, male, born 10/12 1882.*

Up to 1933 the patient had enjoyed good health except for a disposition for catarrh of the air passages and dyspnea (bronchial asthma), always a moderate smoker. Itching spots then appeared on the crura, and shortly afterwards, in January 1934, he experienced tingling and a sensation of chilliness in the hands in cold weather, particularly in the fingertips; in a warm atmosphere afterwards burning pains were succeeded by relief. From April the hands always felt cold, the fingers were painful and cyanotic, and soon blisters appeared on the fingertips. — In the course of the summer there was rather considerable loss of flesh from the fingers. In the autumn I took over the treatment. He had no cervical ribs; Wassermann reaction negative. — His electrocardiogram showed some ventricular extrasystoles, and he had often moderate typical attacks of bronchial asthma. — Otherwise nothing noteworthy beyond the vascular disease.

All medication proved ineffective. His toes, too, were attacked; within the next three years he lost very substantial parts of his fingers and toes, some of them totally, and the hands and feet were swollen and cyanotic.

Operative treatment was early considered but was postponed owing to the patient's private reasons. I had originally thought of performing suprarenal medullectomy, but under the influence of other experiences I began to think of sympathetic ganglionectomy.<sup>1</sup>

From January 1938 to November 1939, four operations were performed; first shortly after one another resection of the III and IV ganglia of the two lumbar sympathetic trunks (7), and about a year later of the ganglion stellatum + the II thoracic ganglion (8) on both sides. The effect was favourable, especially on the feet, which were most painful at the beginning of the operations; it was noticed after each operation that the earlier tendency to loss of flesh was replaced by a considerable tendency to healing; the feet were gradually quite healed, and on the whole remained so.

Thus, according to the circumstances, the condition was fairly satisfactory, in spite of the fact that the hands and feet were still edematous and not quite free from ulcerations, until in the early summer of 1940 there was a severe recurrence which, especially as far as the lower extremities were concerned, in the course of a few weeks caused an ascending diffusion with gangrene. I then made up my mind to try bilateral medullectomy, as I did not at the outset expect any effect from a unilateral resection. Between these two operations amputation of the left lower extremity had to be performed in order to save the patient's life.

The operation on the right suprarenal was performed on the 8/7, on the left on the 7/11 1940. The exacerbation of the process seemed to subside somewhat after the first suprarenal operation; but a distinct effect was only obtained after the second; there was then merely such pain as must be regarded as inevitable in the gangrenous parts of the lower extremity not yet amputated.

After the last suprarenal operation it was sufficient to amputate on the crus on the 17/12, only that which was clearly lost being removed. Bleeding from the wound was slight, it was merely slightly contracted — but shortly afterwards there was a little more bleeding.

That healing was slow is hardly to be wondered at; but in the course of a few months the trophic condition in all the extremities was entirely altered, and has since remained stationary. There was no further loss of substance in the fingers. All pain and all edema have disappeared, all stumps only show the inevitable cicatricial changes, but otherwise look healthy.

Especially when it is warm some red itching infiltrations appear now and then, from quite small ones to patches as big as a palm. The small ones most frequently disappear in a few days, the larger ones persist

<sup>1</sup> My thanks are due to Dr. ARNE BARFRED for having shown, in cooling experiments on the patient's extremities, by means of thermoelectric measurements, that there is a spastic element in the affection.

longer, and for the largest ones some hard, greyish areas of the skin still remain with a slightly bluish-red tinge, more reddish in warm weather. They occur scattered over the thighs, arms, shoulders, and neck, and defy all treatment. Apart from a severe bronchopneumonia with bloody expectorate in July—September 1943, his condition has remained unchanged for over five years. He still sometimes gets mild attacks of asthma. He can walk on prostheses with the aid of two crutches.

LEWIS and PICKERING (6), in »Observations relevant to the so-called Raynaud's disease», mention a group, »B», which entirely coincides with the initial stages of this patient; while the disease later assumed proportions which they mention as occurring but of which, »in order to simplify their account», they do not include examples.

*Case II. Woman, housemaid. Born 29/1 1926.*

In hospital from  $18/12$  1943 to  $12/1$  1944. She had for several years suffered from sensations of chilliness in the lower extremities and a disposition to »frost-bite» so that on both great toes she had gradually got a permanent bluish thickened area of the skin. In December 1943 the condition was considerably exacerbated with strong sensation of cold in both crura with cyanosis, chill, and marked edematous swellings round the malloli, particularly the lateral ones. Otherwise the examination showed nothing abnormal. Examination of the heart including electrocardiography exhibited normal conditions, gynecological examination normal; well proportioned, no varices.

Physical and medicamental therapy and elastic bandages produced little effect; she improved slightly while in bed, but the condition was aggravated directly after discharge so that she became seriously invalided, quite incapacitated.

HÄMÄLÄINEN (9) has convincingly demonstrated the justification for operation, on the basis of extensive experience of lumbar ganglionectomy in cases of damage to the lower extremities due to cold, and has given the indications.

The patient was admitted again and on the  $7/2$  lumbar ganglionectomy was performed per laparotomiam. On the left side the trunk with the ganglia was removed from the aortal bifurcation upward corresponding to the two lower segments. On the right side where the trunk was apparently stouter with slightly larger ganglia, subsequent microscopy showed that two lymph glands had been removed, a mistake also described by WHITE. The result of the operation was therefore highly instructive: the left lower extremity became satisfactory, while even during the next summer the patient still was troubled with sensations of chilliness, chillblains, and decoloration etc. in the right lower extremity.

In November she therefore came back, desiring to be operated again with a view to recovery of the right side. A considerable difference in temperature could be felt. On the right planta measurement of the skin temperature showed  $8^{\circ}$  degrees less than the left, and dorsum pedis

over  $4^{\circ}$  less. The difference was less on the crus and disappeared on the thigh.

She was then operated once more on the  $18/1$  1944 for the removal of the right trunk. As a curiosity it may be mentioned that on the day of operation she said of her own accord that no histological examination need be made of what was removed, she was convinced that the operation had been successful. The histological examination verified the operational results.

Her feet and crura have since been quite in order. But in February 1946 she got "chillblains" on the hands as well as the knees; the latter especially were affected, the skin from just below them to the middle of the thighs where the affection gradually disappeared was much swollen, cyanotic and with numerous ulcerations. It must be noted that in that year the winter was mild in this country, only with a brief moderately severe period of frost just after the New Year. Bilateral medullectomy of the suprarenal glands was then performed in 2 stages on the  $4/2$  and the  $30/3$ . Subsequently she got through the unusually severe winter of 1946—47 without suffering any inconveniences and without being more careful than usual with regard to exposure to cold. Upon examination on the  $26/3$  her extremities were found natural; her hands did not show any thickening of the integuments or ulceration, their colour on a cold day is not different from the normal, a moderately bluish red colour. She feels no discomforts and does full work. At the beginning of April she had a moderate swelling of the hands which subsided of itself.

*Technique of lumbar adrenal medullectomy:* An oblique incision should be made under costa XII, which is mobilised by subperiosteal resection of about 1 cm of the bone close to proc. transversus. — It is then easy to enter and identify the upper pole of the kidney. The operator should work along this until the nearest edge of the suprarenal is found and a suitable area exposed. An incision is made along this, and a blunt instrument inserted. The operator should work in the soft medulla till the suprarenal gland is transformed into a cavity which is then excochleated with a small uterine curette. During this procedure a good deal of the cortex will be removed in addition to the medulla, but enough can always be left to preserve life. Bleeding in the suprarenal stops after short plugging and the wound is best closed primarily. If necessary costa XI can also be mobilised. The author has only done this once, however, in rightsided operation on the above-mentioned patient, who is a very stout man.

*The two cases reported here* seem a great encouragement to perform bilateral suprarenal medullectomy in similar cases. The effect is universal, while the resection of the sympathetic has a local effect. And the operation is comparatively small. There is no doubt,

however, that in severe cases both methods of operation will be called for, partly separately, and partly combined, when they will presumably support each other. That another ganglionectomy (10) than in this work will now be used for the upper extremities, and not only to avoid Horner's syndrome, must expressly be noted.

The question then at once arises how far bilateral suprarenal medullectomy can possibly be utilised in arterial hypertension. The author has a few cases pointing in a markedly positive direction in connection with very limited selective ganglionectomy, but more experience will be needed before anything more positive can be said.

### Summary.

A technique for bilateral suprarenal medullectomy, for clinical use, is indicated, and two cases are reported in which the operation has produced a favourable effect; a severe case of spontaneous gangrene in all extremities and a case of severe frostbite with chronic vascular changes (blue legs). In both cases sympathetic ganglionectomy failed to produce a satisfactory result.

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## On the Treatment of Local Pyogenic Infections with Anticoagulants (Heparin).

By

PH. SANDBLÖM, G. EKSTRÖM and O. QUIST.

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In treating thromboses with anticoagulants, especially in cases of puerperal sepsis, it was early observed that the inflammatory symptoms with fever etc. often regressed parallel with the decrease of the signs of thrombosis (1, 3, 10). An explanation to this which lies close at hand is that the infection-combatting powers of the organism (as well as those eventually administered in form of drugs) have better access to the foci of disease when the thrombus formation in the small vessels and the deposition of fibrin in the tissues lessen. If this explanation is correct a treatment with coagulation-inhibitory measures ought to be efficacious not only in thromboses and emboli of the larger vessels but also in inflammatory processes in which intra- and extra-vascular clotting is an important feature of the pathology.

This view was first put forth by SILVERSKIÖLD (6) in an investigation on the effect of heparin in experimental nephritis. It was taken up and tested clinically in internal medicine by WASSÉN and ZANDER (8) and trials with this treatment have been done in cases of polyarthrititis (8), poliomyelitis (12), pneumonia (9) and psoriasis (5). The results of these trials must be considered very promising; they have, however, for good reasons, been assessed very critically and definite conclusions can not as yet be drawn. G. ZANDER (11) is engaged upon experimental investigations on the effect of anticoagulants on aseptic inflammations with the object of obtaining a more definite basis for the judgment of these questions and GRÉGOIRE (2) has done similar experiments.

As it seemed to be of interest to test this treatment also in pyogenic inflammatory processes, "surgical infections", we have since the spring of 1946 treated selected cases with heparin. The investigation has been carried out, partly at the Surgical Clinic of the Serafimer Hospital (S. H.), partly in the Surgical Department of the Crownprincess Louise's Children's Hospital (C. L. C. H.). The material comprises 24 cases, 18 of which are children and 6 adults. In children various infections have been treated, mainly lymphadenitis and phlegmons. In adults phlegmonous processes only have been treated. Such cases were selected which either did not receive any coincident therapy or which were resistant to other therapeutic measures. The heparin was in all of the cases administered in 4 intravenous doses daily; the children received 2 mg per kg body weight morning and evening and  $\frac{2}{3}$  of this dose twice during the day; the adults received 100 mg  $\times$  4. (Of the Swedish heparin which contains 80 internat. units per mg.)

## Results.

No untoward effects of this treatment have been observed in any instance. In 12 out of the 24 cases treated, all of which were children, the course of the disease was not changed in connection with the heparin treatment, or the result could not be assessed because of a coincident treatment. Short case histories of the remaining 12 cases, 6 adults and 6 children, are presented below.

Cases. Children: I—VI. Adults: VII—XII.

*Case I.* Girl, aged 4 11/12 years. Diagnosis: Infected and indurated contused wound of chin. (C. L. C. H. 1739/46).

Five days prior to admission contused wound on the chin. Phlegmon approximately 3 cm in circumference. Temp. 38.5° C. Heparin from admission 35+25+25+35 mg for 3 days, thereafter afebrile, the phlegmon regressing.

*Case II.* Girl, aged 2 years. Diagnosis: Inguinal adenitis. (C. L. C. H. 1881/46.)

On admission one week after the onset a very tender mass one inch thick in the left groin. Afebrile. Heparin from admission 30+20+20+30 mg. After one day marked regression, after 3 days only a couple of small non-tender adenitis remained.

*Case III.* Girl, aged 5. Diagnosis: Brawny inflammation of right arm. (C. L. C. H. 433/47.)

Acute onset with swelling of the right upper arm and temp. 39° C. On admission 5 days later a large phlegmon on the inner aspect



of the right upper arm and temp.  $38.7^{\circ}$  C. Heparin administered, 25+15+15+25 mg during 7 days. Afebrile already after 2 days, the infiltrate considerably smaller. The subsequent course was afebrile and the infiltrate subsided rapidly. Epicrisis: There was probably a lymphangitis, arising from a surface infection of the hand. The infiltration nearly the size of an egg was reabsorbed without suppuration and with an immediate fall of temperature without any other treatment than heparin. The absence of suppuration in such a large process is unusual.

*Case IV.* Girl, aged 2 10/12 years. Diagnosis: Axillary adenitis. (C. L. C. II. 148/47.)

Onset 4 days prior to admission. Temp.  $38^{\circ}$  C. Large adenitis without signs of suppuration in the left axilla. Heparin 25+20+20+25 mg for 7 days. Afebrile after 3 days, rapid regression without suppuration.

*Case V.* Boy, aged 13. Diagnosis: Cellulitis following wound of foot (osteitis). (C. L. C. II. 182/47.)

One month prior to admission the patient had stepped on a tack with the sole of his right foot. The day before admission tenderness and swelling, redness and tenderness over metatarsus I. Rising temperature. Two days after admission heparin was administered in a dose of 100+60+60+100 mg. Afebrile in 5 days, regression of the swelling of the foot, negligible tenderness. Rapid recovery.

*Case VI.* Boy, aged 4 8/12 years. Diagnosis: Acute osteomyelitis of humerus. (C. L. C. II. 564/47.)

Acute onset 7 days prior to admission with pain in the left upper arm, temp.  $40^{\circ}$  C. Admission to an outside hospital, treatment with sulfa and penicillin. Despite this, temp. one week later  $39.1^{\circ}$  C., marked swelling and redness. Admission C. L. C. II. Continued treatment with sulfa and penicillin. Heparin during 9 days, 40+25+25+40 mg. Afebrile after 4 days, complete reversion of swelling. X-ray on admission did not show any skeletal changes, but 14 days later a porous structure and periosteal deposits in the humerus were observed. Check-up 12 days later showed the process to be walled off, later check-ups showed continued regression. Discharged clinically cured after 5 weeks.

*Case VII.* Male, aged 70. Diagnosis: Carbuncle of neck. (S. H. 2270/46.)

Eight years prior to admission carbuncle at the nape of the neck, which was incised. Present symptoms of 1 week's standing. On admission an indurated, extremely tender infiltrate, rather larger than a tangerine. Afebrile. Heparin 100 mg  $\times$  4. Bedrest. Rapid regression without suppuration.

*Case VIII.* Male, aged 19. Diagnosis: Infected abrasion of shin with inguinal adenitis. (S. H. 584/47.)

Trauma 3 days prior to admission. Twenty-four hours later chills, vomiting, rise in temp. The day prior to admission  $39.5^{\circ}$  C. On admission ill-looking,  $39.8^{\circ}$  C. Surface wound on the lower leg with redness and diffuse swelling of the entire medial aspect of the lower leg. Heparin 100 mg  $\times$  4 for 48 hours. Bedrest. Very rapid regression, nearly critical fall of temperature. Discharged after 2 days, very little remaining suppuration, which was drained by incision. Epicrisis: Extremely

severe infection with marked deterioration of the general condition. The outcome was questionable. Extensive incisions were contemplated. Remarkably rapid regression, small terminal incision of a localised suppuration.

*Case IX.* Male, aged 18. Indurated inflammation of floor of mouth. (S. H. 2835/46.)

One week prior to admission swelling, tenderness, difficulty in swallowing and in opening the mouth. On admission afebrile, a large firm tender infiltrate in the floor of the mouth and downwards bilaterally from ang. mandib. to the middle of the larynx. Redness of the skin, a small submental suppuration. Heparin 100 mg  $\times$  4 for 2 days. Small incision of the suppuration. Rapid regression of the widespread phlegmon.

*Case X.* Female, aged 26. Diagnosis: Furuncle on nose. (S. H. 1548/46.)

Onset 2 days prior to admission. Temp. 38.7° C. Furuncle on the wing of the nose. Phlegmonous swelling and redness of the left cheek over an area the size of a child's palm. Heparin 100 mg  $\times$  4 for 3 days. Speedy regression, lytic fall of temperature.

*Case XI.* Male, aged 22. Diagnosis: Furunculosis of face and abdominal wall. (S. H. 2791/46.)

Onset 1 week prior to admission. On admission furuncle of the cheek, infiltration of the surroundings the size of a child's palm. Heparin 100 mg  $\times$  4 for 3 days. Speedy regression of the phlegmonous infection. A coincident abscess of the abdomen subsided but recidivated after some time, upon which the patient was readmitted. Incision. It is regrettable that the heparin treatment was not carried through at the initial hospitalization.

*Case XII.* Female, aged 39. Diagnosis: Infected abrasion of forearm. (S. H. 1657/46.)

Seven days prior to admission excoriation. On admission swelling of the proximal aspect of the left forearm. Redness, pain, subfebrile. Heparin 100 mg  $\times$  4 for 4 days. Rapid regression. Cured in 6 days.

### Comments.

It appears from the report that in 12 cases out of 24 the infection following the heparin treatment abated rapidly with a prompt fall of temperature. Cases III, VI and VIII are especially noteworthy; in Cases III and VIII large widespread infiltrates of a type that usually results in large suppurations were reabsorbed. In Case VI, an osteomyelitis in which sulfa- and penicillin therapy during 7 days had been without effect the symptoms abated speedily on the introduction of heparin. In the majority of these cases the inflammation had the character of diffuse phlegmons; only 2 cases were acute lymphadenitis. Out of the remaining 12

cases in which no change of the course was observed following the heparin treatment 8 cases were acute septic lymphadenitis, 1 case was an actinomycosis, and 1 case a septic parotitis. In the material presented one thus had the impression that the results were better in those cases in which the inflammation was diffusely phlegmonous than in those cases in which the inflammation was restricted by an organic membrane.

The possibility of forming conclusions from the material presented is curtailed by its smallness and by the fact that these pyogenic processes frequently have a speedy, benign course even without any treatment whatsoever. Until further one must rest content with the observation that in half of the trial cases the infection in connection with the heparin treatment had an unusually favorable course, such as would be expected if the heparin treatment actually had the effect intended. Continued clinical trials are therefore essential, especially (in combination with chemotherapy) in cases of diffuse phlegmonous processes and osteomyelitis; less so, perhaps, in various types of adenitis.

In 1943, L. SIMON (7), advised against the use of heparin in the treatment of newly formed thrombosis following puerperal sepsis believing that spontaneous healing of the sepsis takes place if the thrombus formation is sufficiently massive to prevent the intravenous infection from penetrating through the thrombus.

It would naturally be ill-advised to break down the wall of protection built up by the organism itself in cases in which the septic process is out of control. The suggested treatment ought therefore not to be extended to cases of septicemia or pyemia (or for the same reason not to cases of tuberculosis etc.). With the advance in the field of antibiotics this limitation should be rapidly decreasing.

### Summary.

24 cases of local pyogenic inflammatory processes were treated with heparin on the assumption that the infection-combatting powers would have better access to the foci of disease when the thrombus formation in the small vessels and the deposition of fibrin in the tissues lessen. In half of the cases, especially in those of a diffuse phlegmonous character, the infection had an unusually favorable course in connection with the heparin treatment.

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## Seminal Vesiculitis as an Acute Abdominal Disease.

By

GUNNAR af GEIJERSTAM.

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For many years it has been known that a seminal vesiculitis may give symptoms of an acute abdominal disease. VOELCKER in his monograph on the surgery of the seminal vesicles in 1912 states that the resemblance of the abdominal pain of seminal vesiculitis to that of appendicitis or ureteral colic may be confusing and he cites several authors, who earlier report cases of such diagnostic errors. Also more recently many urologists have written papers on that subject. DAILEY & GRANT in 1924 report three cases of vasovesiculitis simulating appendicitis and point out the necessity of keeping this possibility in mind when deciding the presence or absence of appendicitis in the male. KARTAL presents five cases with seminal vesiculitis, where the erroneous diagnosis was appendicitis or calculus of kidney or ureter. PUGH in 1930 when looking over the files of a large urological department found fifteen cases of definite seminal vesicle disease, that had been subjected to an appendectomy. SINGER states that there are four main sites for referred pain of seminal vesiculitis: the lower abdomen, the course of the ureters, the course of the vas and the epididymes, and the sacral region. He reports cases typical of each. In detail the diagnostic difficulties of acute seminal vesiculitis are discussed by GUTERRIEZ in a greater work on the seminal vesicles. LOWSLEY & KIRWIN in their "Clinical Urology" point out the possible similarity to ureteral colic, appendicitis or even cholecystitis. General surgeons, however, usually seem to have forgotten to include seminal vesiculitis

when making the differential diagnosis of an acute abdomen. Among wellknown textbooks of surgery, where nothing on that subject is to be read, are CHRISTOPHER'S, HOMANS', KIRSCHNER-NORDMANN'S and ROMANIS-MITCHINER'S. DEMEL has specified twenty differential diagnoses to appendicitis, but seminal vesiculitis is not one of them. Nor has NYSTRÖM mentioned seminal vesiculitis in the differential diagnosis of appendicitis in "Nordisk lärobok i kirurgi", the surgical textbook chiefly used by Scandinavian students. Thus the subject seems to be rather disregarded and a short paper on it might be justified.

The origin of the abdominal referred pain at acute seminal vesiculitis may be the seminal vesicle itself or it may be the pelvic peritoneum or the ureter. The pelvic peritoneum covers the top and partly the posterior aspect of the seminal vesicles, then passes over to the anterior surface of the rectum. The contact with the peritoneum is most intimate without any intervening tissue, and a perivesiculitis, that usually follows a graver infection of the vesicles, must cause an irritation of the peritoneum. Cases of septic peritonitis emanating from a ruptured vesicle are also reported, although evidently rather rare. In VOELCKER'S monograph PETER, LLOYD and MITCHELL are cited presenting such cases. HELLSTRÖM has reported a case of peritonitis, that was supposed to originate from a perforated appendix. At the operation the source could not be revealed, but post mortem examination showed a ruptured seminal vesiculitis.

The ureters too lie in close relation to the seminal vesicles as their terminal portion passes between the seminal vesicles and the bladder for a length of about  $1\frac{1}{2}$  cm. Thus a vesiculitis may cause a ureteritis or periureteritis and a distended vesicle may compress the ureter, giving an obstruction accompanied of urinary stasis, eventually hydroureter and hydronephrosis. If a ureter is diseased, there may be symptoms of ureteral or renal colic with abdominal pain and haematuria.

The acute spermatoecystitis is often unilateral or with the symptoms from one side predominating. Especially when the pain is referred to the right lower abdomen and conspicuous subjective symptoms from the genito-urinary system are lacking the correct diagnosis may be difficult to make, if not borne in mind at the outset.

The following cases point out the possibility of diagnostic errors.

*Case I.* B. G., a 20-year-old soldier, was admitted to Karolinska sjukhuset with the diagnosis of acute appendicitis. Except for some urinary frequency during the day of admission the history was quite typical of appendicitis: he awakened from sleep with nausea and diffuse abdominal pain, vomited a couple of times and had a loose bowel movement in the morning. During the day the maximum pain moved to the right lower abdomen. On admission in the afternoon the temperature was 99.7 degrees Fahrenheit and the physical examination revealed tenderness over the right lower abdomen, particularly just medially to Mc Burney's point. Rectal examination showed "pronounced tenderness upwards to the right". The white blood-cell count was 8,500, with 70 % polymorphs. No urinalysis could be made as the patient had voided just before the admission, but the diagnosis of acute appendicitis was considered so certain, that operation was performed immediately. There was some difficulty in removing the appendix, which was situated upwards and lateral to the cecum, but grossly it was not inflamed. Pathologic-anatomic examination also did not reveal any appendicitis. After the operation the patient had persistent abdominal pain, especially in the right lower quadrant and difficulties in voiding. A week after the operation a rectal examination showed that both seminal vesicles were finger-thick, semi-soft and extremely tender. Urethroscopy revealed a partly polypoid posterior urethritis and considerable edematous hypertrophy of the verumontanum. The patient was treated with posterior urethral instillations of silver nitrate, with sulfonamides and later, as the inflammation grew chronic, diathermy, autogenous vaccine, dilation of the posterior urethra and massage of the seminal vesicles and prostate.

Another case, whose history offers several points of interest, especially the long time which passed from the acute onset of the disease until the right diagnosis was established, is the following:

*Case II.* L. E. J., a then 20-years-old soldier, was referred to the Surgical Clinic of Karolinska sjukhuset in May 1945 on account of abdominal pain. His history too was fairly typical of acute appendicitis. Since about 10 hours before the admission he had felt tenderness and stich-like pain in the right lower abdomen. Slight nausea, no vomiting. He showed a distinct tenderness on Mc Burney's point and by rectal examination high up to the right. Temperature 99.7 degrees Fahrenheit. White blood cell count 16,800. An appendectomy was performed but neither macro- nor microscopic examination showed any sign of appendicitis. Soon after the operation he had disturbances of urination: urgency, frequency, burning and urethral discharge. Cystoscopy showed a localised cystitis at the trigone. The urine was essentially negative. Rectal examination showed "tenderness of the prostate". With little success he was treated with urethrovvesical irrigations of silver-nitrate solution and on that account his troubles were believed to be neurotic, at least to some degree. Nor was the cause of his symptoms revealed by a repeated hospital ad-

mission half a year later. In the following year his troubles now and then returned, especially during acute infections of the upper respiratory tract. Early in 1947 he was again admitted to Karolinska sjukhuset. Rectal palpation now disclosed distinctly palpable, tender seminal vesicles and a tender prostate with boggy parts alternating with indurations. The ordinarily voided urine was normal, but after massage and stripping of the prostate and seminal vesicles there were numerous pus cells in the urine and the prostatic-vesicular fluid contained in addition to leukocytes many red blood cells. After treatment with dilatation of the prostatic urethra, digital massage, diathermy, sulfonamides and penicillin the patient has become successively better.

Without doubt an acute seminal vesiculitis was the cause of the first acute symptoms, simulating acute appendicitis. After the appendectomy the disease gradually changed to a chronic prostatic-vesiculitis with typical recurrences especially in connection with other infections.

Since realizing that acute seminal vesiculitis rather often could give symptoms as an acute abdominal condition, especially appendicitis, we have been able to reveal several cases, referred to the hospital with a wrong diagnosis. These cases we have treated adequately from the very beginning and it seems to us that they have been cured more speedily. Such a case is the following.

*Case III.* K. A. E. D., a chauffeur of 24, went to the hospital owing to pain in his right low abdomen for about twenty-four hours. He was able to sleep by night but during the following day the pain increased. No urinary symptoms, no urethral discharge. One year earlier he had had a gonorrheal urethritis with left-sided epididymitis, which had been cured with penicillin. On admission he was afebrile. Moderate tenderness of the right lower abdomen, chiefly below Mc Burney's point, but no rigidity. Corpus epididymidis of both sides somewhat firmer than normal and slightly tender. Rectal examination disclosed a normal prostate but tenderness over the seminal vesicles on both sides. The white cell count was 7,000. Urinalysis showed 5—10 pus cells to a high power field, several clumps of pus cells, Gram-positive cocci and Gram-negative bacilli. No gonococci. The patient was ordered to rest in bed and was treated with sulfonamides in full doses. By the following morning the pain had diminished, abdominal and rectal examination showed no change. Urine negative. Complement fixation reaction showed no gonorrhoea. After two more days the abdominal pain had completely vanished, but by rectal examination the tenderness remained. Gentle expression revealed a slight quantity of prostatic-vesicular secretion, that contained an increased number of pus cells, partly in conglomerate masses, and Gram-positive cocci. A week later, after continued rest, the rectal tenderness had completely disappeared.



As mentioned above, the abdominal pain of seminal vesiculitis also may simulate stone-colic of kidney or ureter. We have not treated any acute case of this kind but a report of a similar chronic one may be of interest.

*Case IV.* N. G. Z., a man of 40, had been examined several times on account of haematuria and lumbo-inguinal pain. No urinary difficulties whatever. Cystoscopy showed a vascular injection of the trigone, but no cystitis, that could explain the haematuria. In spite of several negative intravenous urograms the symptoms of the patient were supposed to arise from a renal calculus, until a careful urological examination, inter alia with urethroscopy, disclosed a chronic seminal vesiculitis and a polypoid posterior urethritis.

The cause of the acute seminal vesiculitis is infection or non-infectious congestion and retention of secretion. Congestive seminal vesiculitis may appear either when excessive sexual irritation is not followed by normal release or when a period of active sexual life is succeeded by a period without possibilities of sexual intercourse. An American naval surgeon, SEABAUGH, presents two cases from the last war, two young males, who had been sexually very active, while in the United States; they were transferred to a small tropical island base, where "contacts with the opposite sex were a luxury, that seldom presented itself". After a couple of months they were taken ill with symptoms of acute appendicitis. In one of the cases appendectomy was performed, the disease of both of them turned out to be non-infectious congestive seminal vesiculitis, which healed after repeated massage.

According to American authors acute seminal vesiculitis in the great majority of cases is of gonorrhoeal origin. WHITE & GRADWOHL found gonococci in 80 %, DELZELL & LOWSLEY a history of gonorrhea in more than 90 % of their cases of infective seminal vesiculitis. GUTERRIEZ states that the origin "nearly always, if not always", is gonococcal. In none of our cases however we have discovered gonococci at microscopic examination of stained smears of urethral discharge or prostato-vesicular secretion, neither has the complement fixation test for gonorrhoea given a positive result. In several cases however there has been gonorrhoeal infection previously, often several years. The probable reason why gonococci are absent as the direct etiological factor in our cases is that acute gonorrhoeal prostato-vesiculitis has been rather seldom seen since the beginning of the sulfonamide-peni-

cillin therapy and that the existing few cases usually get venereological treatment.

As of the above reported cases I—III, the history of a patient with an acute seminal vesiculitis may give little or no evidence of a urogenital disease. Whenever a suspicion of a pathological condition of the seminal vesicles has arisen, a careful investigation of the sexual and urological circumstances of the patient quite often will give indications in the right direction, especially as the acute condition, as a matter of fact, is often an exacerbation of a chronic prostatovesiculitis. However, one seldom goes so far when penetrating the history of a patient with an acute abdomen. The diagnosis instead must rely upon a careful physical exploration. The greatest abdominal tenderness generally is designated as being lower than Mc Burney's point or in the corresponding place on the left side. The rectal examination usually will give a correct diagnosis if it is made with the patient in an adequate position. This is the case when he is standing erect, bending slightly forward, and with his elbows resting on a table. If the examiner is sitting on a chair behind the patient and supports the elbow of his palpating arm on his knee, he is able to reach as high up in the rectum as possible. Just as good as the upright one is the knee-elbow position; in both positions the palpation is made easier if the patient's bladder is filled and the examiner makes a bimanual investigation. In either of these ways the acute diseased seminal vesicle is usually readily felt as a fingerthick, semisoft, very tender swelling backwards and upwards from the base of the prostate. In the acute stage of an infected seminal vesiculitis one should not make a forced trial to express a sample of the vesicular secretion owing to the risk of a spreading of the infection to vas, epididymes etc. at the digital massage. If it is possible to obtain a specimen by gentle pressure, however, it should be carefully collected as the microscopic examination of it may give positive proof of the diagnosis. When the most acute symptoms have disappeared this investigation always ought to be made.

The treatment of acute seminal vesiculitis may briefly be recalled. As mentioned above, the infection seems to be more easily managed, when the treatment begins in the most acute stage of the disease than after even a rather short time. Sulfonamides and penicillin ought to be given as soon as possible and in full doses. The patient has to rest in bed. Any sexual activity is

prohibited and to diminish the often existing excessive sexual irritability barbiturates may be given. Hot sitz bathes, hot rectal irrigations and heat against the perineum often give comfort and diminish the pain. If the history and the physical examination give evidence of a non-infective, congestive vesiculitis there is reason to start a regular stripping of the vesicles at once. On the other hand, in a case of acute bacterial vesiculitis a vesicular massage may be dangerous, as just mentioned. As soon as the acute symptoms have disappeared, if the disease is not yet cured, the usual treatment of subacute or chronic prostato-vesiculitis should be given, viz. diathermy, dilatation of the prostatic urethra, prostato-vesicular massage, possibly topical applications to the posterior urethra and catheterization of the ejaculatory ducts through a urethroscope.

### Summary.

Acute seminal vesiculitis may simulate acute abdominal diseases as appendicitis or ureteral colic. As symptoms from the genito-urinary system not seldom are lacking, the correct diagnosis may be difficult, especially when the abdominal referred pain is predominatingly rightsided. Four cases of seminal vesiculitis are reported, three of them simulating acute appendicitis. In two of these cases appendectomy was performed. The erroneous diagnosis of the remaining case was renal calculus.

The author points out the importance of a careful sexual and urologic history in cases of suspect seminal vesiculitis. The correct diagnosis is confirmed by rectal examination, which should be made with the patient standing erect or in knee-elbow position. The treatment of acute seminal vesiculitis is finally briefly surveyed.

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## A Case of Suprarenal Pheochromocytoma Clinically Diagnosed and Cured by Operation.<sup>1</sup>

By

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Paroxysmal hypertension as a characteristic symptom of a chromaffin tumor of the suprarenal gland was first mentioned in 1922 by LABBÉ, TINEL and DOUMER. As early as 1896, however, FRAENKEL had published a case of suprarenal tumor in an 18-year-old girl (autopsy findings). For a number of years, the girl had been suffering from attacks of headache, vomiting, and palpitations. At the time the tumor was diagnosed as an angiosarcoma but showed the characteristic picture of a pheochromocytoma. PINKOFFS and SHIPLEY, 1929, were able to report a case of tumor of the adrenal medulla — pheochromocytoma — with the now fairly well-known, and typical clinical picture. In this case the correct diagnosis was made before the operation which was successfully performed. A number of cases have since been reported also in Scandinavia, but they are still fairly uncommon and show a very varying clinical picture. The diagnosis is therefore often difficult.

A case of pheochromocytoma, diagnosed and successfully operated upon by us in 1944, is reported below. This case is of special interest because we were in a position to observe the patient clinically and roentgenologically for 4 years before the operation and 3 years after. This is valuable for elucidating the much dis-

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<sup>1</sup> Read at the staff-meeting of the University Clinics, Lund, September 1944. — At the publishing some data from recent literature have been added. — The case was medically examined by one of us, N. A., and transferred to the other, H. B. W., for operation.

cusssed question whether the paroxysmal hypertension may lead to persistent hypertension.

In Scandinavia, at the time of the observation of our patient (1944), only 4 cases of intra-adrenal pheochromocytoma were published in the literature, diagnosed clinically or on operation: BORCH-JOHNSEN (1937), STRÖMBECK and HEDBERG (1939) 1 case each; HOLST (1937) 3 cases. Later GORTZ (1945), JESPERSEN and DAHL-IVERSEN (1946) reported 1 and 2 cases respectively.

In 1939 about 80 cases of pheochromocytoma had been published in the literature; only 9 of them, however, were diagnosed before the operation. Nineteen cases had been operated upon at the time with a mortality rate of 36 %. Most cases up to 1939 have evidently been diagnosed first upon autopsy (STRÖMBECK and HEDBERG op. cit.). In 1942 the total number of cases was 100 (KIRSCHBAUM and BALKIN). Since then, about 20 additional cases of both extra- and intra-adrenal tumors have been reported (DE VRIES et al., 1946). At present the operation has been performed on about 46 patients, with a mortality rate of 26 %.

*Case history:* A 43-year-old taxi-driver was admitted to the Medical Department of the University Hospital, Lund, in the summer of 1944. His chief complaint was attacks of diffuse dyspeptic troubles for more than 1 year, especially vomiting and heartburn. The symptoms did not have any connection with meals but were more frequent after eating fried or spiced food.

Since October 1940, however, the patient was quite incapacitated on account of frequent strange attacks, accompanied by pallor, palpitation, and trembling of the entire body. He had originally been admitted to the University Medical Department, Lund, in 1940. The attacks were then characterized as vasomotoric crises. The symptoms were considered to be of chiefly neurotic type.

A careful anamnesis, however, yields the following data. A previously healthy man, taxi-driver by profession, developed in 1939, at the age of 38, spells of pallor, mainly localized to the face but also spreading to neck, breast, and finger regions. The attacks were accompanied by trembling of the arms, fatigue and sweating. Sometimes the attacks ended with a throbbing sincipital headache.

Initially the attacks had lasted only 1—2 minutes, later they became longer, up to 5—10 minutes. The patient could have from 1 to 5 attacks a day. The first year after onset of the illness the patient was still able to drive a car but afterwards the severity of the attacks made all work impossible. He was thus totally invalidated during the years 1940 to 1944. In October 1940 ( $\frac{1}{10}$ — $\frac{11}{10}$ ) the patient was treated in the Medical Department for his so-called vasomotoric complaints. At this time, the adrenal gland was already suspected and therefore an X-ray examination of these regions was made. The examination  $\frac{7}{10}$

1940 showed no calcifications within the suprarenal region. A re-examination of these films, together with the pictures from 1944, revealed plainly the presence of a rounded, well-defined shadow, the size of an orange, somewhat medially above the right kidney representing the suprarenal tumor which was later operated. Besides this finding, negatively interpreted at the time, slightly higher blood sugar values were found during the first 4 days. No other pathological signs were noted.

Results of examination in June 1944: In the abdomen there was a slight tenderness to pressure in the epigastrium. There was also a feeling of a tumor below the right costal arch. Blood pressure was recorded repeatedly and varied between 125—130 systolic and 85—90 diastolic. The eye fundi were normal. The urine and the renal function tests were normal. The electrocardiogram showed, however, a prolonged conduction time up to 0.29.

The anamnesis pointed rather clearly to a suprarenal tumor being the cause of the symptoms, a pheochromocytoma. The patient was remitted to X-ray examination with the tentative diagnosis of suprarenal tumor (pheochromocytoma).

A soft tissue shadow with a rounded lower pole was observed on the roentgen films in the angle between the liver and the psoas, dislocating the right kidney. There was a suprarenal expansive process, possibly a tumor of the adrenal gland. No calcium deposits in the tumor could be observed.

During the week preceding the operation the patient had no paroxysmal hypertension attacks of the type from which he had suffered the last 4 years. A few abortive spells of very short duration were noted but they were not accompanied by any increase in the blood pressure. Pressure on the site of the tumor produced no attack either. Hyperventilation or vigorous bodily efforts caused no rise in blood pressure. The blood sugar was normal during the patient's entire stay at the Medical Department. A small pathological rise in blood sugar curve to 0.22 occurred, however, after peroral administration of 1 g. glucose per kg. body weight. The excretion of sugar in the urine was 0.76 gm. The sugar tolerance test, as is well known, usually shows a diabetic type of curve in such cases.

There were no signs of hyperthyreosis which may sometimes occur in this disease.

At the time when our case was under observation there were reports by BEER, KING and PRINZMETAL (1937), who had demonstrated by means of a biological method the presence of an increased amount of adrenalin in the blood during an attack. STRÖMBECK and HEDBERG (1939) had also found by means of v. Eulers method that the adrenalin content of the blood was increased up to 30 times the normal amount between the paroxysms, and might be increased 1,000 times during an attack. It should be mentioned that in the latter cases the blood pressure was nor-

mal between the paroxysms. A subcutaneous injection of 2 mg. adrenalin produced about the same increase in the blood sugar of the patient but considerably less increase in blood pressure than a spontaneous attack.

STRÖMBECK and HEDBERG's findings of normal blood pressure when there was a strongly increased amount of adrenalin-increasing substances in the blood, might, provided the method used is exact, indicate a decrease in the sensitivity of the blood pressure-regulating mechanisms for adrenalin in pheochromocytoma. This possibility was investigated by giving our patient and a normal group of 6 persons subcutaneously 1 and 1½ mg. adrenalin respectively. The patient's blood pressure reaction was the same as that of the normal group. This result speaks against a permanent strong increase in the adrenalin content of the blood (a change in the sensitivity of the blood pressure-regulating mechanism to adrenalin) and agrees better with the following data.

By a modification of Hueber's fluorescent method VOLHARD (1944) found normal values for the adrenalin level between the paroxysms and twice that value during the attacks. JESPERSEN and DAHL-IVERSEN (1946) noted in one of their cases a normal or subnormal value between the paroxysms increasing 5 times during an attack (determination according to KAJALA and SAVOLAINEN, 1941). HYMAN och MENCHER (1943) reported increased amount of pressor substance in several cases during paroxysm by perfusing a rabbit's ear.

As the diagnosis pheochromocytoma seemed clear after medical examinations and the X-ray findings, the patient was then transferred to the Surgical Department.

The operation was performed by one of us (H. B. W.) on June 29, 1944. Prior to the operation, during the patient's stay at the Surgical Department, blood pressure, urine volume, carbon dioxide value, blood tests etc., were controlled. Nothing pathological was observed. Both in 1940 and 1944 the X-ray examination of the left suprarenal region revealed nothing abnormal, wherefore no further special control of this region was made in connection with the operation, as, for example, perirenal insufflation or exploration during the operation.

The operation was performed under lumbal anesthesia (18 ml. per-cain). The position and size of the tumor — similar to those of an ordinary tumor of the kidney — induced the employment of the usual although rather large diagonal renal incision on the right side. It was quickly established that the small right kidney, apparently normal, was pushed down, turned over on one side, and somewhat rotated. The displacement was caused by pressure of a rounded and rather compact tumor, the size of a child's head, lying on the side of the adrenal gland.



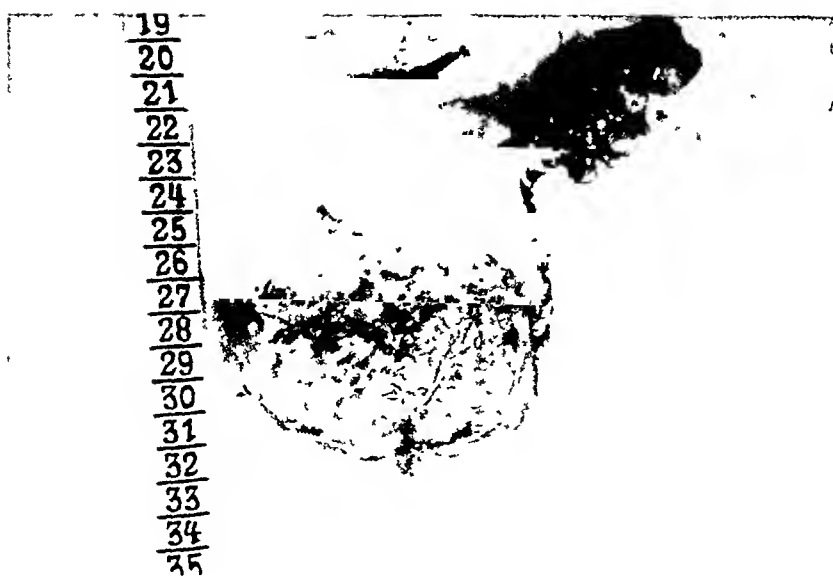


Fig. 1. Phaeochromocytoma



Fig. 2. Phaeochromocytoma; inside view; note the cystic degeneration.



The tumor was of a darkblue—darkbrown colour with quite a number of veins, some the size of the little finger, and very easily bleeding. It had a sharply outlined capsule, which when cut in two, gave easy access to the hilus of the adrenal gland lying on the normal place. The vessels were rapidly ligated with silk. The artery was more than double the size of a match. After the ligation of the vessels it was fairly easy to remove the tumor in its capsule without any hemorrhage occurring. During the operation, however, especially during the process of removing the tumor, the blood pressure was 110/85 mm Hg. Before operation when administering the lumbar anesthesia the blood pressure fluctuated between 125—150. No violent manipulations of the tumor were necessary as the operative conditions were technically easy. After the removal of the tumor, the kidney could be pushed up into its old position. A drain was introduced and 2 g. sulphathiazole were sprayed out in the wound. On the days following the operation the blood pressure, pulse, etc., of the patient were controlled continuously. The blood pressure was constantly 120—110.

Only at the end of the operation when the blood pressure dropped to 85 mm. Hg., the patient experienced a slight shock, which, however, disappeared rapidly after a blood transfusion of 450 ml. The post-operative course was mainly uneventful. During the first two days a subcutaneous injection of 1,000 ml. of saline solution was given and on the day after the operation another blood transfusion of 500 ml. Various cortical hormones were kept ready for use but the good general condition, normal blood pressure and normal pulse rendered these preparations superfluous. The urea, serum albumin and alkali reserve values remained quite normal.

*Pathologic examination. Macroscopic description:* The specimen was a rounded tumor, the size of a child's head, with a capsule. The colour was darkbrown to cyanotic-red. In the centre of the preparation there was a cyst the size of a goose-egg filled with a slightly bloodtinged liquid. The tissue of the tumor was lined radially both externally and internally with a more central section in the middle surrounding the cyst. The specimen exclusive of the contents of the cyst weighed 910 gm. The size and appearance of the cyst are shown in Fig. 1.

*Microscopic examination:* The suprarenal tumor was composed of large cells, rich in plasma, with a large, rounded or oval nucleus and a distinct nuclear body. In some areas the cells were smaller and the nuclear chromatin condensed. The cytoplasm was finely granulated, sometimes showing hyalin drops. Now and then layers of blackish-brown pigment could be noted within the tumor cells or in the stroma. The tumor cells formed suggestive alveolar groups. Externally, the tumor is encased in a connective tissue capsule, internally it presents a cystic process. There was no mitosis and no infiltrations of the tumor capsule. Diagnosis: pheochromocytoma. (C. G. AHLSTRÖM).

During the first 10 days after the operation the patient was subfebrile and had a slight suppuration in the wound. He was discharged 25 days after the operation, however, entirely symptomfree, healed, and with a normal blood pressure of 120 mm. Hg. After the operation,

during his stay in the hospital, he had no attacks or trouble of the kind that had made him an invalid the last 4 years.

After 2 months the patient resumed his former occupation as a taxi-driver and has experienced no trouble whatsoever in his work. At the present time (September 1947) he is quite well. Blood pressure was 115/120 and 75/80, heart and pulse normal. Urine normal. Blood values normal. During this time of more than 3 years after the operation no symptoms of the former disease have occurred and the man is quite capable of working.

### Comment.

Of special interest for the anamnesis and differential diagnosis was the marked abdominal pains of peptic ulcer type, which — the patient's earlier trouble of paroxysmal "vasomotoric insufficiency" being almost his subjectively normal state since 4 years — somewhat dimmed, the otherwise characteristic clinical picture of a pheochromocytoma. The diagnosis seemed, however, certain after a careful anamnestic analysis and X-ray examination. The latter examination was decisive, especially as roentgen films taken 4 years previously revealed positive findings of a tumor shadow in the suprarenal region.

Many of these cases, however, are diagnostically much more complicated. In many cases some kind of X-ray examination as urography (or pyelography), planography, and perirenal oxygen insufflation determines the diagnosis.

Urography, one of the most exact roentgen diagnostic methods known, can often provide us with excellent information even in perirenal tumors and should be used in all suspect cases of suprarenal tumors. If, for some reason, urography does not yield sufficient result, pyelography may prove useful. Small suprarenal tumors are not visible on usual survey pictures and do not necessarily produce any effects visible even by urography or pyelography (DE VRIES et. al.). Tomography or planography (DE VRIES et al.) may then give excellent results but a certain experience is needed with this method. Perirenal insufflation, of which one of us (H. B. W.) has seen positive results without any noticeable disadvantages (MAC CULLAGH and ENGEL), should be used when the previously mentioned methods do not yield sufficient information.

In most cases the pheochromocytoma can be diagnosed by one of these methods, sometimes, perhaps, with an extra assistance of bio-chemical methods, but occasional cases are sure to require

operative exploration of the suprarenal areas. Such an exploration should be used also in those cases where positive findings on one side are combined with uncertain findings in the suprarenal region of the other side. In such cases it is of minor importance whether the transabdominal or the retroperitoneal approach is used. Personally one of us (H. B. W.) has had satisfactory results with the latter method, used among others in a case of suprarenal tumor with Cushing's syndrome, where the unaffected side was not quite normal roentgenologically. In these cases it is often the question of small tumors wherefore the retroperitoneal way gives sufficient access, is more convenient for the patient, and, with the modern intubation anesthetic technique, is employed with minimal risks.

In diagnostically certain suprarenal tumors the transabdominal or retroperitoneal approach may be used with equally good results. The main point is to obtain good access to the suprarenal tumor, and to reach the hilum rapidly without undue manipulations of the tumor. Otherwise there is the risk of greatly increasing the adrenalin in the blood causing dangerous rises in the blood pressure (STRÖMBECK-HEDBERG and DE VRIES et al.). A satisfactory access can be obtained by both methods.

The primary results of the operations performed before 1936 were rather unsatisfactory. The real nature of the tumor was often diagnosed first during the operation, or, perhaps, even after the operation. The pre-operative preparations and the extremely important immediate postoperative treatment were therefore inadequate. It may be mentioned that before 1936 the mortality rate reached 36 %. The operation mortality of the 46 patients operated on and reported in the literature (our own included), is 26 %. The progress in operative technique and in the important postoperative treatment is best demonstrated by the fact that until the end of 1936 seven deaths occurred among 17 operations, whereas of the 22 patients operated upon after 1936 only 3 deaths were reported.

The late results in cases of pheochromocytoma operated upon are but little known. It appears from the few reports published until now that, after successful operation, the recovery is complete, without noticeable after-effects on the vascular system although attacks of frequent and obvious paroxysmal hypertension may have occurred for years. There are cases reported, however, who suffer from persisting hypertension with grave and de-

finitive damages of the vessels of the retina, brain, heart, kidneys, etc., showing in other words the clinical symptoms of a malignant hypertension (CREMER; THORN and HINDEL).

In the foregoing case report, symptoms of the suprarenal gland could be demonstrated to have existed for more than 4 years, accompanied by numerous spells of hypertension and total invalidity. After operation the patient has now been observed for more than 3 years but no noticeable vascular changes have been observed.

### Summary.

A 43-year-old man was completely invalidated for 4 years on account of attacks of pallor, perspiration, trembling, and, during the last year, spells and symptoms similar to those in ulcer cases. The clinical diagnosis: pheochromocytoma, was verified by roentgen examination. A large, suprarenal tumor on the right side was found. Re-examination of pictures taken 4 years previously revealed a suprarenal tumor. The tumor, a pheochromocytoma, was successfully removed by operation following which the symptoms disappeared completely. Three years after the operation the patient is still quite healthy and able to work in his old profession.

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## Cancer of the Colon.

A Survey of the Material for the Years 1931—1946.

By

BJARNE FRETHEIM.

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Cancer of the colon is one of the relatively most common manifestations of cancer. The Norwegian medical statistics for 1941 shows that 70 per cent of all deaths of cancer are due to cancer in the alimentary tract, and that 40 per cent of all cancer deaths are due to cancer of the stomach, 10 per cent to cancer of the colon and rectum, the incidence being about equally divided in the two latter organs. During the 16 year period 1931—1946, 644 cases of cancer of the stomach, 114 cases of cancer of the colon, and 107 cases of cancer of the rectum were diagnosed at Drammen Hospital.

The material of cancer of the colon, cancer of the rectum being excluded, consists of 60 males and 54 females with the following age distribution.

20—29 years	30—39 years	40—49 years	50—59 years	60—69 years	70—79 years	80—89 years
1	6	9	30	34	31	3
1 %	5 %	8 %	26 %	30 %	27 %	3 %

The pathologico-anatomical examination in 68 patients operated upon showed:

Adeno carcinoma	Colloid cancer	Little diff. cancer	Mucipar cancer	Lympho- blastoma
55	8	3	1	1

The material is divided into two groups, one in which the cancer is located to the right part of the colon to the middle of the trans-

verse colon, in the other to the left part of the colon to the rectum at the iliopectinal line. In 42 cases the cancer was situated in the right part of the colon (a little more than one third), and in 72 cases in the left part of the colon (less than two thirds).

The usual symptoms from the onset of the initial symptoms till the diagnosis was made, are shown in table 1.

Table 1.  
*The different symptoms in cancer of the colon.*

Symptoms	Right half 42 patients	Left half 72 patients	Total 114 patients
Non-characteristic abdominal pains.	27 (64 %)	40 (55 %)	67 (58 %)
Ileus .....	7 (17 %)	26 (36 %)	33 (29 %)
Subileus .....	20 (50 %)	31 (43 %)	51 (44 %)
Constipation .....	17 (40 %)	39 (54 %)	56 (50 %)
Diarrhea .....	4 (10 %)	6 (8 %)	10 (9 %)
Diarrhea and obstipation alternating	6 (14 %)	9 (12 %)	15 (13 %)
Macroscopical blood in the feces ...	4 (10 %)	9 (12 %)	13 (11 %)
The tumor palpated by the patient.	2 (5 %)	2 (3 %)	4 (4 %)
Local or diffuse peritonitis. Fever.	6 (14 %)	5 (7 %)	11 (10 %)
Constitutional symptoms (general malaise, anorexia, loss of weight)	27 (64 %)	32 (44 %)	59 (52 %)

Non-characteristic abdominal pains are the most common symptom, often increasing to subileus-resembling, colicky pains. These symptoms are more marked in cancer of the right than in cancer of the left part of the colon. On the contrary, complete ileus is twice as common in cancer of the left as in cancer of the right part of the colon, and occurs in a total of 29 per cent of the cases.

Next most common are changes in the bowel habits, as a rule constipation, more common in cancer of the left than in cancer of the right part of the colon.

Constitutional symptoms are the third most common feature, the incidence higher in cancer of the right than in cancer of the left part of the colon.

Finally, there is a number of exceptional symptoms. Such are inflammatory symptoms, which occur in 10 per cent of the cases, and which are three times as frequent in cancer of the right as in cancer of the left part of the colon. Thus, 4 cases of cecal cancer were treated as appendicular abscess, 2 being treated conservatively, 2 by incision. One case of cecal cancer and 2 cases of cancer of the sigmoid colon, were for a long time running a sub-



febrile temperature with recurrent chills as the only symptom. Two of these patients were radically operated upon with good results, but the operation did not reveal the cause of the fever. The third patient died of a perforative peritonitis. Diffuse peritonitis was found in 2 cases of cancer of the left part of the colon with a complete ileus and an enormous distention of the colon, increasing towards the cecum, but no perforation of the gut could be seen.

Macroscopical blood in the feces had been noticed by the patients without difference as to cancer of the right or of the left part of the colon (11 per cent). In 4 per cent of the cases the patients had palpated the tumor themselves.

The first symptoms noticed by the patients are shown in table 2. Non-characteristic abdominal pains are the predominant feature, a little more common in cancer of the right than in cancer of the left part of the colon.

Table 2.

*Initial symptoms in cancer of the colon.*

Symptoms	Right half 42 patients	Left half 72 patients	Total 114 patients
Non-characteristic abdominal pains.	27 (64 %)	38 (53 %)	65 (57 %)
Subileus .....	7 (17 %)	10 (14 %)	17 (15 %)
Ileus .....	1 (2 %)	4 (5 %)	5 (4 %)
Constipation .....	2 (5 %)	15 (20 %)	17 (15 %)
Diarrhea .....	1 (2 %)	4 (5 %)	5 (4 %)
Macroscopical blood in the feces ...	2 (5 %)	4 (5 %)	6 (5 %)
The tumor palpated by the patient.	2 (5 %)	2 (3 %)	4 (4 %)
Local or diffuse peritonitis. Fever ..	5 (12 %)	3 (4 %)	8 (7 %)
Constitutional symptoms (general malaise, anorexia, loss of weight)	6 (14 %)	10 (14 %)	16 (14 %)

On the contrary, stenosal symptoms are more common in cancer of the left part of the colon.

The duration of the past history before the diagnosis was made, is shown in table 3. The past history is less than 6 months in 79 per cent of the patients.

Patients with a short past history do not show a greater operability than those with a history of long duration. There is rather evidence to the contrary. There is no principal difference between cancer of the left part and cancer of the right part of the colon as to the duration of the past history.

**Table 3.**  
*Duration of the past history.*

Duration	Right half		Left half		Total	
	Inop.	Oper.	Inop.	Oper.	Inop.	Oper.
Less than 1 month .....	4	5	13	9	17	14
1—6 months .....	14	10	11	24	25	34
6—12 „ .....	0	5	4	3	4	8
12—18 „ .....	0	1	1	3	1	4
18—24 „ .....	0	2	0	2	0	4
More than 24 months .....	0	1	0	2	0	3

The routine examination when cancer of the colon is suspected includes:

- a) Abdominal and rectal palpation.
- b) Examination of the feces for occult blood.
- c) Blood examinations: Hb., serum proteins, sedimentation rate.

d) Roentgenological examination.

Where peritoneal metastases have not been present, tumor has not been palpated on rectal examination in any of the cases. Tumor felt by abdominal palpation is recorded in 42 per cent, and here four times more frequently in cancer of the right part than in cancer of the left part of the colon (Table 4).

**Table 4.**  
*Palpable tumor.*

	Right half		Left half		Total	
Operable .....	19		7		26	
Inoperable .....	14		8		22	
Total	33	(78 %)	15	(20 %)	48	(42 %)

In cancer of the right part of the colon, tumor has been palpable with the same incidence as to operability and inoperability, but in cancer of the left part of the colon, the incidence of palpable tumor has been relatively much higher in inoperable than in operable cases.

Occult blood in the feces has been detected by the benzidine test (Table 5). The figures show no difference regarding the location of the cancer. Predominantly, or constantly positive benzidine reactions are found in 80 per cent, and demonstrate the great

Table 5.

*The blood reaction in feces.*

(73 patients.)

B+: Positive, or chiefly positive reactions.

B+—: Approximately as many negative as positive reactions.

B—: Negative, or chiefly negative reactions.

Right half			Left half			Total		
B+	B+—	B—	B+	B+—	B—	B+	B+—	B—
25	2	4	35	2	5	60	4	9
80 %	7 %	13 %	80 %	5 %	15 %	80 %	6 %	14 %

importance of this examination. In several cases it has been the repeated positive benzidine reactions which have led to a correct diagnosis, and in two cases the diagnosis was insisted upon in spite of negative findings on physical and roentgenological examinations.

Table 6.

*Hemoglobin percentage in 84 patients with cancer of the colon.*

*Normal hemoglobin percentage:* above 100 per cent in males, above 90 per cent in females.

*Slight anemia:* 100—75 per cent in males, 90—70 per cent in females.

*Grave anemia:* Less than 75 per cent in males, less than 70 per cent in females.

Normal hgb. percentage			Slight anemia			Grave anemia		
Right	Left	Total	Right	Left	Total	Right	Left	Total
15	24	39	15	15	30	10	5	15
37 %	55 %	46 %	37 %	34 %	35 %	26 %	11 %	19 %

The hemoglobin content (Hb%) was decreased in 54 per cent of the cases, the number per cent being greater in cancer of the right than in cancer of the left part of the colon. The incidence of anemia is about equally divided between operable and inoperable cases. General malaise and anemia have in three instances been the only reason for the admittance to the hospital.

The concentration of serum proteins (S.P.) was decreased in 19 of 26 cases (70 per cent), which means a higher incidence than for the anemia (Table 7). Thus, normal hemoglobin values were found in 9 cases where the concentration of serum proteins was decreased.

The sedimentation rate (S.R. mm/hour) shows no difference as to the location of the cancer, nor regarding operability and in-

Table 7.

*The concentration of serum proteins in 26 patients with cancer of the colon.*

Normal values: above 6.5 Gm%.

Slight hypoproteinemia: 6.5—5.5 Gm%.

Grave hypoproteinemia: less than 5.5 Gm%.

Normal S.P.			Slight hypoproteinemia			Grave hypoproteinemia		
Right	Left	Total	Right	Left	Total	Right	Left	Total
3	4	7	7	11	18	0	1	1
30 %	25 %	27 %	70 %	69 %	69 %	0	6 %	4 %

operability (Table 8). 25 per cent of the patients had a normal sedimentation rate.

Table 8.

*The sedimentation rate in 76 patients with cancer of the colon.*

Normal S.R.: below 10 mm. in males, below 12 mm. in females.

Moderately increased S.R.: above 30 mm.

Strongly increased S.R.: above 30 mm.

	Normal S.R.	Moderately incr.	Strongly incr.
Inoperable .....	6	7	19
Operable .....	13	21	20
Total	19	28	39

Roentgenological examination with barium enema was positive in 91 per cent, evidently more often in cancer of the left than in cancer of the right part of the colon, the latter in which most of the doubtful and negative findings occur (Table 9). First the second or third roentgenological examination yielded positive findings in 2 cases of cancer of the right part of the colon. This still leaves 15 per cent of cancer of the right part of the colon with negative

Table 9.

*The roentgenological findings in 92 patients with cancer of the colon.*

First time examination.

Right half			Left half			Total		
Posi- tive	Doubt- ful	Nega- tive	Posi- tive	Doubt- ful	Nega- tive	Posi- tive	Doubt- ful	Nega- tive
28	2	5	55	1	1	83	3	6
80 %	6 %	14 %	96 %	2 %	2 %	91 %	3 %	6 %

or doubtful findings, but only 4 per cent in cancer of the left part of the colon. This marks the importance of not giving up the diagnosis on account of negative roentgenograms as long as clinical evidence suggests cancer of the colon, especially in cases where cancer of the right part of the colon is suspected.

Of the 114 patients with cancer of the colon, 67 (59 per cent) could be radically operated without regard to the cancer being located in the left or right part of the colon (Table 10). Palliative operation was performed on 21 cases (18 per cent) with a primary mortality rate of 66 per cent. Colostomy was performed on 12 cases, 10 of which died, and enteroanastomosis in 9 cases of which 4 died. In 8 of the cases the death was due to peritonitis, otherwise to other causes. Most of the patients were so ill at the time of the operation that they would have died at any rate. The patients who were not radically operated, and who are discharged from the hospital have had an average survival of 5 months, those laparotomized, or not operated, 4 months, and those palliatively operated, 7 months.

Table 10.

*Operability in cancer of the colon.*

	Right half	Left half	Total
Exploratory laparotomized, or not operated .....	9	17	26 (23 %)
Palliatively operated (colostomy or anastomosis) .....	9	12	21 (18 %)
Radically operated .....	24 (57 %)	43 (60 %)	67 (59 %)

The radical operation in cancer of the right part of the colon consisted of hemicolectomy and ileotransversostomy in one or two stages and in cancer of the left part of the colon, resection and anastomosis with or without a previous colostomy, or a Bloch-Mikulicz's operation, was used (Table 11).

In cancer of the right part of the colon, radical operation in one stage has been performed on 18 patients (75 per cent), 4 (22 per cent) of which died in the hospital. 6 patients have been operated in two stages an ileotransversostomy being performed first, followed by a hemicolectomy some weeks later. Here no deaths occurred in the hospital, in spite of the fact that only severely ill patients were operated in two stages. The total operational mortality rate has been 17 per cent in cancer of the right part of the colon.

Table 11.

*Radical operation in 67 patients with cancer of the colon.*

	Right half		Left half		Total	
	Number	Mortal.	Number	Mortal.	Number	Mortal.
Bloch-Mikulicz's operation			12	2	12	2
Primary resection	18	4	28 %	17 %	36	6
	75 %	22 %	42 %	11 %		
Primary resection, the obstruction being relieved in advance	6	0	13	3	19	3
	25 %		30 %	23 %		
Total	24	4	43	7	67	11
		17 %		16 %		16 %

In cancer of the left part of the colon, primary resection and anastomosis was performed on 31 cases (72 per cent). In 13 of those cases the operation was preceded by colostomy, as a rule a cecostomy. The total mortality rate has here been 16 per cent. The fact that the mortality rate was two times greater in cases where the obstruction has been relieved by a temporary colostomy, is explained by the fact that this was performed only on the acutely ill patients, *i. e.*, those in which ileus had developed.

The Bloch-Mikulicz's operation was used in 12 cases (26 per cent) without any selection of the material being made. The mortality rate was here 17 per cent, *i. e.*, practically the same as for primary resection and anastomosis. In our opinion it makes no difference, therefore, either of which of the two methods are employed regarding the operational mortality rate.

Table 12.

*The postoperative cause of death in patients radically operated for cancer of the colon.*

	Right	Left	Total
Poor general condition, shock .....	0	1	1
Local or diffuse peritonitis .....	2	3	5
Ileus .....	1	1	2
Pneumonia .....	1	1	2
Anuria .....	0	1	1

The causes of postoperative deaths are shown in table 12. The most common cause is local, or diffuse peritonitis. Next are postoperative ileus and pneumonia.

Table 13.

*Complications in patients radically operated for cancer of the colon.*

	Right	Left	Total
Fecal fistula .....	0	7	7
Local peritonitis .....	3	3	6
Diffuse peritonitis .....	2	2	4
Wound rupture .....	2	0	2
Ileus .....	1	2	3
Anuria .....	1	1	2
Pneumonia .....	1	1	2
Thrombo-embolia .....	0	3	3

The significant complications which occur in connection with the radical operation, are shown in table 13. Most commonly, local or diffuse peritonitis without fecal fistula is found. Fecal fistula is next most common. This occurred all in cases of cancer of the left part of the colon, in 4 cases of those treated with the Bloch-Mikulicz's operation, after the closure of the colostomy, and in 3 cases of those treated with primary resection and anastomosis. The fistulas closed spontaneously after a shorter or longer period, partly after repeated attempts at operative closure.

Postoperative ileus occurred in 3 cases, 2 of which ended fatally. The third patient got a complete mechanical ileus at the site of the resection after resection of a sigmoid cancer on Rankin's forceps. The ileus was diagnosed roentgenologically, the contrast showing linear stop. A cecostomy was performed, and, successively, passage was established as the catgut sutures, which probably had been fastened too deeply, loosened.

Postoperative wound rupture occurred in 2 cases of cancer of the right part of the colon. In one instance there came a complete wound rupture with spontaneous eventration on the fifth day after the operation. Secondary wound suture was made, and the further course was uneventful. The other patient had a partial rupture which healed, but a ventral hernia developed.

Anuria occurred after the operation in 2 cases, one in which the cause was unknown (shock?), and this patient died. In the other case the cause was sulfathiazole intoxication, and this patient recovered spontaneously.

In 4 cases of cancer of the cecum the diagnosis was first appendicitis with abscess, and in two of these patients the abscess was incised and drained. Both these patients were later radically operated. One of the patients had then had his fecal fistula for two

years after the incision. The primary result was good. The two other patients were also radically operated, but one died of a postoperative, diffuse peritonitis, the other 5 months later of metastases.

In cancer of the right part of the colon, a relatively constant operational method has been used, but in cancer of the left part of the colon the methods have varied. Three types of operations have been used: 1) The Bloch-Mikulicz's operation. 2) Open resection. 3) Resection on Rankin's forceps ("closed resection"). In table 14 the deaths and complications (wound infection, peritonitis, fecal fistula, ileus) which are directly related to the operational methods, are specified.

Table 14.

*Deaths and complications directly caused by the operational technic in patients radically operated for cancer of the left part of the colon.*

Method	Bloch-Mikulicz's op. 12 cases	Open resection 9 cases	Resection on Rankin's forceps — 22 cases
Mortality .....	0	2 (22 %)	2 (9 %)
Complications ..	4 (33 %)	2 (22 %)	7 (32 %)

In the Bloch-Mikulicz's operation there are no deaths which may be said to have been directly caused by the method, but in one third of the cases, fecal fistula developed after attempts to close the prenaternal anus. In the open resection serious complications occurred in 2 cases (one fifth) which both ended fatally (local peritonitis + poor general condition, and diffuse peritonitis). In the closed resection complications occurred in one third of the cases, two of which ended fatally (peritonitis and ileus). This seems to indicate that the Bloch-Mikulicz's operation is the safest of the three.

Estimating the hospitalization period of the patient from the first operation till the day of discharge from the hospital after the radical operation, the Bloch-Mikulicz's operation is found to be the most unfavourable one (Table 15) with a hospitalization period averaging four times that of primary resection in one stage. The reason for the great mortality and for the long-continued hospitalization in group 5 is that this group consisted of very ill patients compared with those in group 4. No selection of the material was made for the Bloch-Mikulicz's operation, which thus must be compared with the total number of primary resections with anastomosis. The mortality rate for the Bloch-Mikulicz's



operation and the primary resections is thus the same (16—17 per cent), while the average duration of the hospitalization after the Bloch-Mikulicz's operation is more than twice that after primary resection.

Table 15.

*Duration of the hospitalization from the first operation till the discharge from the hospital after the radical operation.*

Operational method	Number	Hospitalization
1. Hemicolectomia dextr. One seance	18	Minimum 14 days, maximum $2\frac{1}{2}$ months, average $1\frac{1}{3}$ month
2. Hemicolectomia dextr. Two seances	6	Minimum $1\frac{1}{2}$ month, maximum 3 months, average $2\frac{1}{2}$ months
3. Bloch-Mikulicz's operation	12	Minimum $1\frac{1}{2}$ month, maximum 9 months, average $4\frac{1}{3}$ months
4. Primary resection, left half	18	Minimum 13 days, maximum 4 months, average 1 month
5. Primary resection, left half, the obstruction being relieved in advance	13	Minimum $1\frac{1}{3}$ month, maximum $6\frac{1}{2}$ months, average 3 months

The difference is considerably less as to the hospitalization period after right hemicolectomy in one or two seances, just about 1 month.

Table 16.

*Emergency cases among patients operated for cancer of the colon.*

	Right half	Left half	Total
Radically operated .....	1	17	18
Palliatively operated, or exploratory laparotomized .....	3	6	9
Total	4 (10 %)	23 (32 %)	27 (24 %)

The operation in one or two stages depends to a certain extent on whether the patient is operated upon as an emergency case or not (Table 16). From this it is evident that one third of the patients with cancer of the left part of the colon have been operated upon as emergency cases, the number per cent here being three times as great as that in cancer of the right part of the colon. In cancer of the right part of the colon, radical operation could be performed on one fourth of these cases only, while it in cancer of the left part of the colon was performed on three fourths of the patients. This is above all due to the fact that cancer of the left part of the

colon may cause symptoms of ileus at a relatively early stage, while these symptoms of cancer of the right part of the colon are a relatively late manifestation of the disease.

Table 17.

*Age and mortality rate in patients radically operated for cancer of the colon.*

Age	Number		Deaths		Mortality
	R.	L.	R.	L.	
30—39 years .....	2	3	0	2	40 %
40—49 » .....	4	3	2	0	30 %
50—59 » .....	5	13	0	0	0
60—69 » .....	8	15	2	3	21 %
70—79 » .....	5	9	0	2	14 %

The relation between age and mortality is shown in table 17. The largest mortality rate is found in the younger patients (30—49 years), and may partly be due to the more malign forms which occur in this group, and partly also to the fact that the condition is diagnosed relatively late.

Table 18.

*Survival of patients radically operated for cancer of the colon who are discharged from the hospital.*

Survivals	Right colon	Left colon	Total
Alive after 1 year ....	11 of 15 (73 %)	26 of 31 (84 %)	37 of 48 (80 %)
Alive after 3 years ...	5 of 13 (37 %)	14 of 24 (58 %)	19 of 37 (51 %)
Alive after 5 years ...	3 of 12 (25 %)	10 of 17 (59 %)	13 of 29 (45 %)

Radically operated patients who are discharged from the hospital have a postoperative survival of 1, 3, and 5 years as indicated in table 18. The table shows that the prognosis is worse for all ages in cancer of the right part of the colon than in cancer of the left part, the number per cent of survivals in cancer of the left being twice that in cancer of the right part of the colon, respectively 59 and 25 per cent, after 5 years. The total number alive after this period is 45 per cent.

There is no relation between the sedimentation rate and the prognosis. Nor is there any relation between anemia and marked constitutional symptoms before the operation, and the survival after the operation.

### Comment.

The initial symptoms in the vast majority of cases of cancer of the colon are non-characteristical abdominal pains, which do not indicate any special disease. This is especially found in cancer of the right part of the colon. Next most common are changes in the bowel habits, subileus-resembling colicky pains, or ileus, which directly indicate intestinal disease.

Macroscopical blood in the feces, or palpable tumor, are seldom the first symptom. The symptoms may be directly confusing, as in 4 cases of cancer of the cecum, where the disease first was diagnosed as appendicitis with abscess. Where the only symptom has been recurrent chills, as in 3 of our cases, or where there have only been constitutional symptoms, such as general malaise, anorexia, and loss of weight, it may be impossible to locate the disease.

During the further course of the disease, symptoms of serious affection of the large bowel will become more marked, stenosal symptoms being the more pronounced ones in cancer of the left part of the colon, constitutional symptoms being the more pronounced in cancer of the right part.

Three methods of examination are very important in order to diagnose the condition. These are abdominal palpation, the benzidine test in the feces, and the roentgenological examination.

In cancer of the right part of the colon the tumor had been palpated in four fifths of the cases, but only in one fifth of the cases of cancer of the left part of the colon.

Repeated positive benzidine reactions in the feces are so frequently found in cancer of the colon, that the diagnosis must not be dismissed even if the roentgenological examination should be negative, as long as the possibility of cancer of the colon exists and no other cause of the hemorrhage is found. On the contrary, negative benzidine reactions do not exclude cancer of the colon.

However, the most important, and as a rule decisive examination, is the roentgenological examination with barium enema. But here, too, it must be remembered that negative roentgenograms do not exclude cancer of the colon, and the examination should be repeated in cases where cancer is suspected. It should also be noted that the roentgenological diagnosis in cancer of the right part of the colon very often may be as well uncertain as difficult.

Regarding the operability, the duration of the past history seems to be of little importance. Patients with a history of more than two years' duration have been radically operated. Nor is the age of the patient of essential importance, and even patients at the age of about 80 years have been operated radically with success.

Nor does palpable tumor as a rule permit definitive conclusions. Even when the surrounding organs are infiltrated, complicated resections may be performed with good results. Clinical evidence of peritoneal or hematogenous metastases are though as a rule a sign of inoperability. In some instances a palliative operation may be indicated. As a whole one should be radical regarding the indications for operative treatment, as the patients, even when only a palliative operation is possible, are much better off for the time left when the tumor is removed, than when they die of the primary tumor.

A large number of the patients, when they come for the operation, are in a very poor general condition. Anemia and hypoproteinemia are common, and, without being investigated in our material, hypovitaminosis is probably present, and vitamin B and vitamin C should be paid special attention. Preoperative treatment should, therefore, consist of a high protein and low residue diet with an abundance of vitamins, and the bowel should be thoroughly emptied. To reduce the risk of infection, sulfonamides (succinylsulfathiazole or fthalylsulfathiazole) should be administered the last days before the operation, partly as an attempt to inactivate the intestinal flora, partly to reduce an eventual inflammation around the tumor. If indicated, iron and transfusions of blood or plasma should be given, at the same time as the fluid-electrolyte balance should be controlled.

When the patients are in such a poor condition that an adequate preoperative treatment is impossible, this might be made possible by simple operations. In cancer of the right part of the colon we have as a rule used ileotransversostomy. In cancer of the left part of the colon cecostomy has been employed.

Spinal anesthesia has been preferred, but a fall in the blood pressure and shock should be watched out for.

Where no special complications have been present, the operation has usually been performed in one stage. In cancer of the right part of the colon, this has been done in three fourths of the cases, but it is probably advisable more often to operate in two stages,

as in the one fourth where this has been done, no postoperative deaths occurred, while 4 deaths occurred among those operated in one stage. It also appears that careful preoperative treatment should be carried out, especially in cancer of the right part of the colon. Both our cases of spontaneous wound rupture occurred in cancer of the right part of the colon. During the last years we have always used sulfathiazole powder locally around the anastomosis. In special cases parenteral or peroral administration of the drug has been used. Whatever due to the sulfonamide treatment, or to better operational technic, it appears that wound infection after this procedure is much more infrequent.

In cancer of the left part of the colon we have alternated between the Bloch-Mikulicz's operation (one fourth of the cases) and primary resection of the tumor with anastomosis, with or without the obstruction being previously relieved by operation. Little seems though to be obtained by performing a temporary operation where symptoms of ileus are missing. Operation as an emergency aid had though to be performed on one third of the patients with cancer of the left part of the colon. Which of the two, the Bloch-Mikulicz's operation or primary resection and anastomosis, shall be preferred, is in our opinion not conclusive, neither of the mortality nor of the survival, even if there is evidence indicating the Bloch-Mikulicz's operation being the safer of the two. Nor is there any difference as to the postoperative complications. On the contrary, there is a considerable difference regarding the hospitalization period after the operation, which is more than twice as long for the Bloch-Mikulicz's operation as for primary resection and anastomosis.

The survival after the radical operation is in our material considerably longer in cancer of the left part than in cancer of the right part of the colon. In cancer of the right part of the colon the operational mortality as well as the survival after the operation is practically the same as in our material of radically operated cases of cancer of the stomach during the same period (E. JENSEN). The operational mortality is also the same in cancer of the left part of the colon, but the survival is considerably longer than in cancer of the right part of the colon and cancer of the stomach. One may imagine that cancer of the left part of the colon could be classified with cancer of the rectum. The operational mortality is the same, but after 5 years only half as many of the radically operated patients with cancer of the rectum are alive, compared with

those with cancer of the left part of the colon (K. LIAVAAG). In this connection it is surely of importance that cancer of the left part of the colon will present symptoms at an earlier stage and thus receive earlier operative treatment.

From our material it appears that cancer of the right part of the colon is a more malign condition than cancer of the left part, presenting more marked constitutional symptoms and also poorer final results after radical operation.

### Summary.

114 cases of cancer of the colon and the most important symptoms and clinical manifestations of the condition are mentioned. The material is divided in cancers of the right and cancers of the left part of the colon. 59 per cent of the patients have been radically operated, with a mortality rate of 16 per cent. Operation in one stage is preferred in uncomplicated cases. 5 years' survival was found in an average of 45 per cent, 25 per cent in cancer of the right, 59 per cent in cancer of the left part of the colon.

### Literature.

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## Jejunitis Acuta — Ileitis Regionalis Acuta.

By

B. CHR. BRYNJULFSEN.

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Only during the last 10—15 years has frequent reference been made to the acute, non-specific, phlegmonous processes in the small intestine. It is in particular regional enteritis, notable in its chronic form, on which attention has been focussed. Most of the publications have been Anglo-American since CROHN-GINZBURG and OPPENHEIMER published in 1932 the first comprehensive study of regional ileitis. Our conception of its aetiology still rests mainly on a series of hypotheses.

There may be two main forms of acute, non-specific, inflammatory lesions of the small intestine according to if the disease is seated mainly in the mucosa or the submucosa. In the first instance the patient may be admitted to a medical ward, and in the latter to a surgical ward where we find conditions of late often described as terminal ileitis or ileitis regionalis. This latter term has gradually gained acceptance as the morbid process does not always occur in the terminal portion of the ileum, but may be elsewhere in the small intestine as well as in the colon. It is a phlegmonous inflammation. But there is also a phlegmonous inflammation located in particular to the upper portion of the small intestine and presenting a pathological-anatomical picture resembling that of regional ileitis, but seeming clinically to possess a quite different character with regard to malignancy. The terms generally applied to these conditions have been enteritis phlegmonosa or acute phlegmonous jejunitis or duodeno-jejunitis acuta. There is also the lymphadenitis mesenterialis so familiar to the surgeons. In 1938, FR. HARBITZ was of the opinion that it is a mild form of acute ileitis, and there is much evidence to support him.

The material I have examined during the past 12 years belongs mainly to the Surgical Department of the Bergen City Hospital, Haukeland. Five cases of jejunitis were treated in the Medical Department and one in the Epidemiological Department of this hospital. Two specialists in Bergen have also kindly let me publish some of their cases.

*Treated in hospital:*

Acute phlegmonous jejunitis (severe form) .....	16 cases
Acute phlegmonous jejunitis (light form) .....	3 »
Acute terminal ileitis .....	14 »

*Treated outside hospital:*

Acute phlegmonous jejunitis (light form) .....	2 »
Acute terminal ileitis .....	2 »

Jejunitis and ileitis are essentially different, particularly with regard to prognosis, for as many as 14 of the 16 severe cases of acute phlegmonous jejunitis were fatal whereas only one of the ileitis patients died (of embolism after ileo-coecal resection).

Here I shall treat each group separately and divide the jejunitis group into two, *i. e.* severe and light forms.

Phlegmonous enteritis was mentioned by ROKITANSKY in 1842, but the first complete account of a case was given in 1875 by the Swedes BELFRAGE and HEDENIUS. Other Swedes, including FRISING and SJÖWALL (1913), HOLMDAHL (1916) and N. HELLSTRÖM (1919) have made close studies of this disease. In Norway, HJORT (1930) recorded a case of phlegmonous duodenitis, and referred to two other cases which MURSTAD and SEMB respectively had communicated to the Surgical Association in Oslo in 1926. I have been unable to find other communications on this disease in Norwegian publications. However, in 1927, RÖMCKE gave an account of enteritis ulcerosa jejuni which differed in several respects from the condition I am about to discuss. It may, however, be included in the same group of diseases.

### **Acute Phlegmonous Jejunitis (Severe Cases).**

Among my six male and ten female cases are two children aged respectively 16 months and 11 years. All the other patients were over 30, four being between 30 and 54, four between 55 and 60,



and six over 70, the two oldest being 79. It will thus be seen that most of the patients were well on in life, though the disease may occur in childhood. My small figures do not suggest any sex predisposition. HELLSTRÖM found 19 males among the 30 published cases in which the patient's sex was mentioned. His investigations also showed that most patients are elderly, 22 of 27 being over 30, 16 over 50, and six over 60. FRISING and SJÖVALL found that nine out of ten patients were over 50.

*Symptomatology.* Among my 16 cases there was only one (among the most recent) in which the diagnosis was made clinically before operation. In 1919, HELLSTRÖM pointed out that in none of the cases hitherto published had the disease been diagnosed before operation, and not always then. There is therefore justification for a closer study of this disease whose manifestations vary greatly. Yet there are several which recur constantly and are of diagnostic importance. The course of the following case may be characteristic.

*Nr. 1.* A man, aged 31, was admitted in 1940 to the Epidemiological Department for abdominal pain. Next day he was transferred to the Surgical Department with the diagnosis of ileus. During the past five years he had had bouts of epigastric pain with nausea and vomiting not related to his meals. Ten days before admission he had felt relaxed, and a little later epigastric pain and vomiting had set in. Next day he passed three loose stools. He had stayed in bed and complained of constant, slight, muttering pain in the epigastrium. He was constipated and vomited twice.

On the day before admission his illness had changed character, and he had complained of severe colic in the gastrum, particularly on the left side. He had also complained of nausea and shivering, and of bouts of pain in his stomach which "went into knots". There had been no passage of flatus or faeces. From the moment of his admission to the Epidemiological Department, the clinical picture became more and more suggestive of intestinal obstruction. The severe colic was referred to the upper abdomen. There seemed to be a palpable, soft, round tumour in the left epigastrium over which numerous intestinal sounds could be heard. He slept badly at night in spite of 1 eg. morphine and 2 eg. thebaicin. On admission to the Surgical Department he was much exhausted and in great pain.

Temperature: 39.1, pulse 140, soft. Tongue dry and coated. Urine normal. Abdomen possibly a trifle large, meteorism. It was soft everywhere, but there was tenderness on pressure over the epigastrium. No palpable distension.

A yellowish-brown fluid, smelling of faeces, was aspirated (800 cc.) from the stomach. He was then given tutofuein. A radiological examination showed coils of colon distended with air on both sides as well as

distension of the transverse colon and sigmoid. There were no definite pockets of air in coils of small intestine. A barium enema showed nothing of interest.

Intestinal obstruction being probable, an *exploratory laparotomy* was made under spinal anaesthesia through an incision in the middle line below the umbilicus. No increase of fluid in the peritoneal cavity. The first coils of intestine seen were normal. The long and large sigmoid showed nothing pathological. The small intestine was traced upwards till the flexure was reached. The uppermost 30—40 cm. of the jejunum were thicker and larger than usual, but without injection of the serosa. What was, however, definitely pathological was the state of numerous, soft, mesenteric glands whose size attained that of a bean. Palpation of the other organs, including the pancreas, proved negative, and the abdomen was closed. No change during the next three days. Temperature from 38.5 to 39. Stinking fluid was aspirated from the stomach twice a day. Much fluid was given, but the patient became increasingly confused and delirious.

The abdomen continued to be slightly distended but not tender. There were numerous intestinal sounds and a constant escape of a little flatus. Leucocytes 19,000 on the day after the operation. As the lower portion of the intestinal tract was still plainly functioning, a fistula was established on the third day after the operation. *Jejunostomia*. Left-sided, diarectal incision above the umbilicus. Much light-yellow fluid in the peritoneal cavity. The appearance of the jejunum had changed completely, and it was now as thick as a man's wrist, oedematous and injected, its walls thickened. A plentiful deposit of fibrin on the uppermost 60—70 cm. of the intestine resulting in certain coils being matted together. The mesenteric glands had become larger, more firm and more yellow. All these changes were most marked in the upper part of the jejunum, becoming less so as they were traced downwards, but they were still considerable even at a level 1.5 metres from the flexure. Jejunostomy was performed and the abdomen closed. Some improvement during the first few days. Then he became steadily worse, and he died ten days after admission.

Tests for typhoid, paratyphoid and dysentery proved negative. Under the microscope a lymphatic gland, removed at the first operation, showed hyperplasia. Another lymphatic gland, removed at the second operation, showed hyperplasia with haemorrhage. The day before he died, diastase 32, urobilin 1/50 +, Gmelin ÷.

A post-mortem examination some 17—18 hours after death showed diffuse peritonitis and the changes in the jejunum already recorded. At one place on its wall there was a discoloured area as large as a fig. The transition to normal intestine was even. The mucous membrane of the dilated section of the intestine was green-black. Broncho-pneumonia, parenchymatous degeneration of the liver and some enlargement of the 165 g. spleen which was not softened.

What was particularly noteworthy was the great contrast between the violence of the clinical manifestations and the slightness of the morbid changes found at the first operation. The rapid development

of the disease during the three days between the two operations was also remarkable.

As there is little to be gained by recording all 16 cases in detail I will now discuss their most characteristic manifestations.

The onset of the disease was usually quite acute, and occasionally it was preceded by a few days of general malaise or a brief period of vague, chiefly gastro-intestinal symptoms. Some patients had had bouts of pain in the epigastrium or under the costal arch. The duration of the illness before admission to hospital varied considerably, from six hours to ten days, generally not more than three days (11 cases). One patient was ill for four days, two for five days and two for eight to ten days. These figures show that the rate of onset and intensity of the disease can vary considerably. One may expect the symptoms to become so severe, as a rule, in the course of a few days that admission to hospital is necessary.

The diagnoses on admission to hospital are significant: Acute abdomen (4), ileus (5), gastro-enteritis (3), peritonitis (1), ulcer with haemorrhage (1), imminent diabetic coma (1), intestinal disease (1). In all 16 cases the onset of the disease was acute. In 13 it began with pain, and in several also with diarrhoea. In a case of chronic nephritis, manifestations of uraemia were prominent. In two cases diarrhoea was the first manifestation, one of them being that of the 16-months old child. In one case the manifestations of diabetic coma were prominent.

Pain, the symptom most in evidence, was usually intense, but it could also be moderate and "muttering". Sometimes it was an ache, sometimes colicky, but it did not radiate outwards except in the case of imminent diabetic coma in which it radiated to the back. Sometimes the whole abdomen was painful without being more so at one point than another. In some cases the pain was above the umbilicus, and in three it was in the left epigastrium. It might grow in intensity or set in with full force at once. It was never as severe as that of perforating ulcer. A certain diagnostic importance may be attached to pain in the left epigastrium or at any rate above the umbilicus.

Nausea and vomiting were present in all my cases with the exception of the 11-year-old girl, whose record contained no reference to them. In eight of the 16 cases the vomiting became gradually faecal. Its diagnostic significance is considerable, only in a couple of my cases did vomiting play a subordinate part.

The action of the bowels deserves close attention. Diarrhoea

was quite common in my material, but in the literature I have not found any detailed reference to it. In the cases in which stools have been referred to, their passage seems to have been obstructed rather than the reverse. Five of my patients suffered from constipation and 11 from diarrhoea which, after lasting a few days, was succeeded by constipation. In five cases the diarrhoea lasted all the time, and in three of them it was blood-stained. It is therefore plain that diarrhoea was an important feature in the present material. Sooner or later most of the patients suffered from difficulties with the passage of the contents of the intestines verging on complete intestinal obstruction. Special importance attaches to this phenomenon if preceded by diarrhoea.

The patient's general condition attracts attention at once. All my patients were obviously exhausted, being seen at a first glance to be very ill. The exhaustion in several cases was greater than one would have expected from the clinical findings, particularly the abdominal findings. This contrast may be of some diagnostic value. Pallor has often been noted in these cases in which the temperature is raised and the pulse is rapid and often alarming. In nine of my cases the temperature on admission to hospital was over 38, and in five it was over 39. In three cases shivering was recorded.

In ten of my 16 cases there was some distension of the abdomen which was tender on palpation; in a few cases the tenderness was severe, but as a rule it was slight. When it is situated in the left upper abdomen, it may be of some diagnostic value. Release tenderness was observed in a couple of cases. As a rule, tenderness was associated with rigidity, but in several cases rigidity was conspicuous by its absence. It corresponded to tenderness in distribution, and was slight in all my cases. Only in two cases was there a palpable swelling, in the left flank in one case, in the left epigastrium in the other. Intestinal sounds were referred to in nine cases, in one of which they were normal, in four absent, and resonant in four others. Intestinal distension was not observed even in the cases in which intestinal obstruction had been diagnosed.

In seven cases the urine was examined for diastase (Wohlgemuth's test) and in four cases figures over 128 were found. In two cases the figure of 512 was reached, but only after operation. The same patients were examined for urobilin (Larsen's test) and only in four cases were the figures over  $1/10 + (1/260 \text{ maximum})$ . Gmelin's test was negative (four cases). The diastase

examination may possibly help to distinguish this disease from acute pancreatitis. It seems natural that the diastase should be raised as there must be oedema of the posterior abdominal wall in close proximity to the pancreas. In none of my cases was jaundice noticed, but other observers have found it in cases of duodenitis.

Leucocyte counts in eight cases invariably showed leucocytosis, from 10,600 to 29,900. Four patients whose blood was examined showed shift to the left, and one of them showed toxic granulation. There was never any increase in the number of the eosinophiles. The blood sedimentation rate was examined only once before operation and was then 90 mm. A raised SR must be expected.

What has just been said of the signs and symptoms explains the variety of diagnoses on admission to hospital. The present material falls into two groups from the purely clinical point of view although the differences between them were not sharply defined:

- a. An ileus-like type ..... 8 cases
- b. An enteritic type ..... 5 cases

a. To judge by the literature, the ileus-like type is the more common. In this group we also find symptoms suggestive of peritonitis. The eight patients suddenly felt pain and a sense of severe illness. In many cases diarrhoea of some days' duration was followed by constipation. The pain often came in bouts and was usually situated in the upper abdomen, notably on the left side. There was fever with, in some cases, shivering. Attacks of vomiting, at first isolated, became more frequent and tended to be faecal, although this did not necessarily happen. The tenderness and rigidity throughout the abdomen were usually slight and out of all proportion to the patient's sense of severe illness. We were tempted to suspect peritonitis or intestinal obstruction without succeeding in completely harmonizing them with the clinical picture. This description tallies very well with that given in earlier publications.

b. The enteritic type, observed in five of my cases, was mainly characterized by diarrhoea. Though pain might be severe, it attracted less attention than the diarrhoea which in one case was blood-stained, and in two cases quite black, with benzidin +++ . The diarrhoea sometimes ceased suddenly as in the case admitted

to the Epidemiological Department for gastro-enteritis. The cessation of the diarrhoea was followed by the development of an ileus-like condition. In this type of the disease, and at any rate as long as the diarrhoea lasts, gastro-enteritis, dysentery etc. will be suspected. But here, again, it is difficult to make a correct diagnosis as there will also often be features indicative of embarrassed intestinal action. The other manifestations of the disease are those of the first group.

In three cases it was impossible to fit the clinical picture into either of the above-mentioned groups. Two of these patients were, however, as old as 79, and the records of their previous histories were incomplete. As our material grows, we must expect to find a certain number of cases in which the clinical picture is "atypical".

*Diagnosis.* Among the 16 cases was one (nr 4. See table p. 374) in which the diagnosis was just a guess, and it was observed shortly after one of our patients had died without being operated on and without any diagnosis. Only in one other case was the diagnosis made before operation (nr. 2). In the six cases in which an operation was performed, the operation diagnoses were respectively abscess, peritonitis, ileus (2), nil and jejunitis.

Though the diagnosis is said to be very difficult, FRISING and SÖVALL hold that the clinical picture is not so lacking in characteristic features as hitherto supposed, and that the late onset of peritonitis and an occasional tenderness with resistance render a correct diagnosis possible. In saying this they assume an adequate knowledge of this disease on the part of the operator. I also believe, but on slightly different premises, that the disease can be diagnosed in most cases, for I attach great importance to a radiological examination provided this disease is kept in mind. This point is most important when a surgeon is confronted by an abdominal case out of the ordinary. If he is not familiar with this disease, he may fail to recognize it even at an operation. When, in such a case, the patient dies of peritonitis and is not examined post mortem, the diagnosis will be peritonitis of unknown origin.

The diseases of most importance to the differential diagnosis are ordinary intestinal obstruction, perforation peritonitis and diseases of the pancreas. It is difficult to distinguish between duodenitis with jaundice and diseases of the biliary passages. Typhoid fever, dysentery and non-specific forms of gastroenteritis must be considered as possible diagnoses. Among the more rare



Fig. 1 a. X-ray photo of small intestine one month after operation, taken half-an-hour after the administration of barium by mouth.

Fig. 1 b. X-ray photo of small intestine a month-and-a-half after operation, taken one hour after the administration of barium by mouth.



Fig. 2 a. Patient M. F. X-ray photo taken on admission to hospital half-an-hour after the administration of barium by mouth.

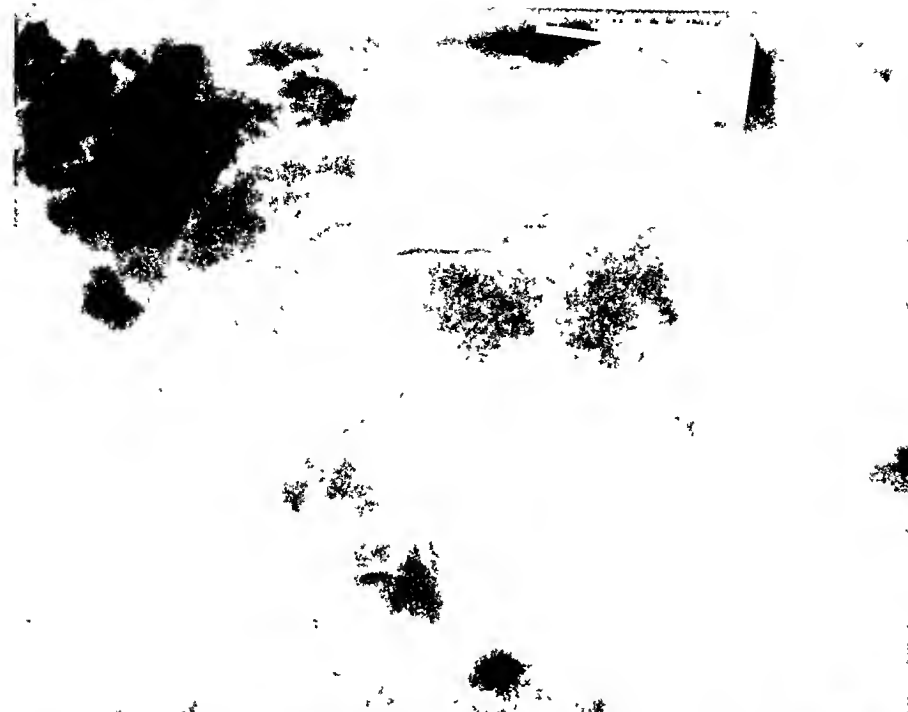


Fig. 2 b. Patient M. F. X-ray photo taken on admission to hospital an hour-and-a-half after administration of barium by mouth.



diseases is phlegmonous gastritis whose manifestations may be so like those of phlegmonous processes in the upper portion of the small intestine that one cannot hope to distinguish between them by clinical examination only. We can also not expect to distinguish between disease of the duodenum and of the jejunum, the more so because it is often situated simultaneously in both these sections of the intestinal tract.

A radiological examination is most important. A comprehensive skiagram will in many cases provide useful clues if the disease in question is borne in mind and the clinical picture is compared with the radiological findings. A contrast meal, given by the mouth, provides the most useful information, but the patient's condition will often render such an examination difficult. A comprehensive skiagram may well show air in the small intestine, limited or extensive, with perhaps a fluid level in some cases. The radiological picture is, in other words, that of ileus, in most cases a high ileus. A comparison of this finding with the clinical picture may suggest a certain discrepancy, for example the radiological evidence of ileus is less marked than expected, or one is puzzled by the simultaneous and severe diarrhoea. If we add to the problem the existence of phenomena indicative of an infection, we have every reason for keeping in mind the possibility of phlegmonous jejunitis. This possibility is increased if a radiological examination is suggestive of an enteritis. In the case of a woman, aged 58, with a characteristic history of diarrhoea, great prostration and vomiting becoming gradually faecal (the ileus-like type), we diagnosed jejunitis, and here the radiologist's report after a radiological survey of the abdomen fitted in with the diagnosis of peritoneal irritation or jejunitis. An exploratory laparotomy was confirmatory, definite jejunitis being found limited to the upper portion of the jejunum. White and haemolytic staphylococci were found in the scanty effusion in the abdominal cavity. She recovered after treatment with penicillin. A contrast meal a month after the operation showed definite changes as seen in the accompanying skiagrams. (Fig. 1 a and 1 b.)

Here we see changes of tonus, irregular mucous membrane relief with delayed passage, a fluid level, and air in the intestine. At the first radiological re-examination a month after the operation, more than 2½ hours elapsed before the upper jejunum was empty. A month-and-a-half after the operation, this process took less than 2 hours, and it was not till three months after the opera-

tion that normal conditions were restored. This observation is very interesting as it shows how long full recovery takes in spite of a "clinical cure".

On the whole, I believe that in most cases it should be possible to make the right diagnosis if we link up the history of the case with the objective and clinical findings and with a radiological examination. We must, however, also expect to find cases in which the symptoms are so atypical that the correct diagnosis is impossible particularly, perhaps, in elderly and debilitated patients and in the presence of complicating lesions.

*Prognosis.* All the 41 cases collected by BUNDSCHUH terminated fatally with the exception of MERGE's case which ended in recovery after resection. Other authors are also pessimistic. Among my 16 patients were two who recovered. Patient nr 2 recovered under penicillin treatment; it was remarkable how quickly improvement followed this treatment.

The course of the 14 fatal cases was rapid, nine of the patients living only two to five days after the onset of their symptoms, and four from one to three weeks, and one over four weeks after. One of my patients lived for 32 days. This is assuredly exceptional. The prognosis must still be considered very bad even though penicillin or other remedies may effect a change. We need more experience, and to achieve early treatment we must ensure early diagnosis.

*Treatment.* This has hitherto been futile. The best measure is supposed to be resection, but it is very seldom feasible, the disease usually being too extensive or in too awkward a situation or the patient too ill for this operation. It would be quite exceptional for a severe case of jejunitis to be cured by resection.

Such palliative treatment as jejunostomy or gastro-enterostomy has been attempted as well as drainage to the involved section of the intestine or tamponade. Incisions to give relief have also been proposed. Operative treatment has not, however, improved the prognosis. As a rule, an operation consists of an exploratory laparotomy as in four of my cases. Only six of my patients were operated on, two undergoing jejunostomy. In principle I recommend an exploratory laparotomy through a diarectal incision on the left side. The diagnosis can thereby be confirmed and specimens obtained from the peritoneum or mesenteric glands for culture. Cultures can also be taken from the wall of the intestine if the operator dares puncture it. In rare cases resection can be

undertaken through healthy tissue. An exploratory laparotomy affords clues to further treatment, for pyogenic germs and occasionally the colon bacillus appear to play an important part, and we now have effective remedies against them. Certain chemotherapeutic drugs and penicillin in large doses should be given a trial. My patient treated with penicillin received one million units altogether, 120,000 being given daily. In view of the rarity of this disease, it will be long before we have much experience of this treatment which should be beneficial when pyogenic germs play an important part. Treatment should also include the introduction of a Miller-Abbott tube and aspiration of the contents of the intestine.

*Pathological Anatomy.* The macroscopic phlegmonous inflammation will be seen under the microscope to show a predilection for the submucosa. All the layers of the intestine are, of course, involved, and the changes in them may be so profound that it is impossible to make sure of their starting point. Even a quite common enteritis gives rise to changes involving the whole of the intestine if they are sufficiently marked. As a rule, pus is not visible on section, merely a thickened and oedematous intestinal wall. But one may also find a layer of yellow pus as in cases of phlegmonous gastritis.

In only one of my cases was there macroscopic evidence of pus in the wall of the intestine, and here the pus was strictly limited. In other cases there was a phlegmonous process of greater or less extent; or there were morbid changes at several points between which the intestine was normal. The macroscopic appearance varies greatly with the stage of the disease at which an operation is performed, and with the speed with which the disease proves fatal. The intestine is found to be injected, oedematous, thickened and also often somewhat distended, with deposits of fibrin and slight adhesions. As a rule, the morbid process diminishes as it is traced downwards, the transition from morbid to healthy intestine being either fairly abrupt or more gradual. The duodenum alone may be involved, and when the disease is not very marked, it is easily overlooked at an operation. The disease may also be limited to the upper jejunum or to a point further down in it. It is perhaps at about the flexure and for a short distance below it that the process usually begins. On cutting open the intestine, one finds its walls thickened and oedematous, and on rare occasions pus may be found. The mucous membrane is usually intact, but

it is often discoloured, and there may be ulcers which are usually small and few in number. They seem to be secondary to the rest of the process.

The following table gives a brief survey of the pathological findings at operation and post-mortem examination. The numbers are those belonging to the case records.

It was common to find lymphangitis and lymphadenitis wide spread throughout the lymphatic tract. The mesentery was often somewhat oedematous and thickened, the seat of small haemorrhages. The lymphatic glands, either quite soft or firmly elastic, were enlarged, being often of the size of a bean. Their colour was light yellow, but they were never broken down as in tuberculosis. Abscesses between the walls of the mesentery have, however, been described. MÜLLER has observed an abscess of 400 cc. and HELLSTRÖM one of 100 cc. between the walls of the mesentery. The oedema of the mesentery may be quite marked, particularly when the process is situated in the duodenum, in which case great retro-duodenal oedema is always to be found.

My material suggests that purulent peritonitis comes late, while a peritoneal reaction in the form of fluid effusion and, in particular, a deposit of fibrin tend to develop in conformity with the intensity of the intestinal disease, witness the operation findings. Among my six cases undergoing operation were five presenting a peritoneal reaction as indicated by the scanty, slightly cloudy fluid and a deposit of fibrin on the affected sections of the intestine.

As indicated by the post-mortem findings, the pathological anatomical processes vary considerably, and conclusions cannot be drawn from the clinical picture as to the extent and intensity of the disease. The clinical picture is the same, and the course of the disease is equally rapid, whether the whole of the small intestine is involved or only a short section of the jejunum. It may be convenient to class the pathological-anatomical findings in three groups:

- A. Short, confluent processes (up to 100—150 cm.).
- B. Extensive, confluent processes (the whole of the jejunum or the whole of the intestine).
- C. Circular processes with normal intestine in between.

My material shows:

Group A. in eight cases.

Group B. in two cases.

Group C. in six cases.

The circular distribution of the disease by segments seems to be by no means rare. The microscopic picture is that of an inflammation situated mainly in the submucosa. As we are dealing with post-mortem sections, little importance attaches to the condition of the mucosa because of early autolysis. In most cases the mucosa is more or less destroyed, and there is enormous oedematous thickening of the submucosa with diffuse infiltration with cells. They are mainly polynuclear leucocytes, but there are also lymphocytes, plasma cells, eosinophile leucocytes and macrophages. Numerous giant cells of the foreign body type were found in a couple of cases. In a few cases the profusion of lymphocytes may be striking. But, as a rule, the polynuclear leucocytes are in the majority. In a few cases the submucosa presented a layer of pus not macroscopically visible. In most cases a scanty cell infiltration through the muscular coat, with changes on the serous side of the intestine, could also be seen under the microscope in those parts on which there was a microscopic deposit of fibrin. The microscopic picture was evidently that of a non-specific, acute or subacute inflammatory process showing a preference for the submucosa. There was no evidence of any specific inflammation.

Thanks to the courtesy of the pathologist, E. WAALER, M. D., I have made Gram-stained preparations of most of the post-mortem specimens. Various Gram-positive and Gram-negative rods and cocci were most frequently found, and in a couple of cases also short, Gram-positive chains, but no one definite microbic form seemed usually to be dominant. Only in three instances was this the case; here there were great numbers of staphylococci, partly in large and well-defined heaps in the submucosa, partly in confluent masses. These germs would seem to be responsible for the changes found in these three cases in which no cultures were taken.

*Actiology.* No definite causal factor has been discovered. It is natural to suspect a variety of causes and factors such as individual predisposition and powers of resistance. Older authors such as ROKITANSKY, FOERSTER and LEUBE assumed a metastatic in-

Nr	Age	Duration of disease	Operation on admission
1	M. 31	Lived 20 (11) days	First op. 10 days before death. Light jejunitis. 30—40 cm. No peritonitis. Second op. 3 days later showed severe disease for 60—70 cm., visible jejunitis. 30—40 cm. No peritonitis. 150 cm. Sero-fib. perit.
2	F. 58	Ill 1 week before adm. Recovery.	Upper 30 cm. of jejunum slightly involved. Thickening for about 90 cm. Serous perit.
3	F. 55	Lived 1.5 day	20 cm. much involved. Sero-pus and fibrin in abd. Intestine rather dark at one point (starting point?)
4	M. 55	Lived 4 days	Explor. incis. in left flank 3 days before death. Coils of small intest. matted together. Sero-fib. perit.
5	M. 30	Lived 2 days. Died directly after adm.	
6	F. 73	Lived 3 days. Died directly after adm.	
7	F. 60	Lived 5 days	
8	F. 71	Lived 6 days	
9	F. 42	Lived 12 days	Fib. perit. without marked increase of fluid 3 days before death. Uppermost 50 cm. of jej. much involved. A small necrotic area.
10	M. 16 months	Lived 2 days. Died directly after adm.	
11	F. 75	Lived 8 days	
12	F. 70	Lived 2 days	
13	M. 54	Lived 3 days	
14	F. 11	Ill for 2 days before adm. Recovery	Jej. injected and thickened. No fluid in abd.
15	M. 79	Ill for 2 days. Died directly after adm.	
16	F. 79	Lived for 32 days.	

ble.

Starting pt. of the disease	Post-mortem findings	
	Its length	State of peritoneum
Fl. duod.-jej.	80 cm., and slighter changes for some further distance.	Diffuse purulent peritonitis with much fibrin.
Fl. duod.-jej.	30 cm.	Diffuse purulent peritonitis with much fibrin.
60 cm below fl. d-j.	About 20 cm.	Dif. pur. perit. with much fib. Haemor. in muc. of duod. and upper jej. Pus infilt. of size of nut. No for. body vis.
20 cm below fl. d-j.	60 cm. Also several circ. sects. involved, becoming less marked when traced downwards.	Smooth, glistening peritoneum. A little blood-stained fluid. Fibrin adhs. Haemor. small intest. (Sero-fib-perit.)
Fl. d-j.	All the small intest. Less in colon	No perit. Patchy inject. of perit. with small haemors. Light diabetes mell.
8 cm above fl. d-j.	In all jej. 3—7 cm. — long circ. sects. involved, less well mkd. when tred. downwards. Intest. norm. in between.	Fib. adhesions. A little blood-stained, cloudy fluid. Haemor. left supraren. Gallsts. (sero-fib. perit.).
Fl. d-j.	75 cm.	Diff. pur. perit. with much fibrin.
Fl. d-j.	50 cm.	Sero-fib. perit. with scanty, cloudy fluid.
35 cm below fl. d-j.	70 cm. Further down a couple of sim. changes less marked.	Sero-fib. perit. with yellow-green serous fluid.
Fl. d-j.	30—50 cm much aff. Also for 150 cm further down several circ. sects. involved.	Sero-fib. perit. with a serous fluid.
Fl. d-j.	120 cm. Several circ. sects. much injected.	Sero-fib. perit. with some adhs. and scanty blood-stained fluid.
Fl. d-j.	All the small intest., dimin. when traced downwards.	Serous perit. Smooth peritoneum. 100 ml. watery, red-brown fl. Sev. dia.
Fl. d-j.	1—4 cm. long circ. sects. involved for a distance of 50 cm.	Sero-fib. perit. with cloudy fluid. Uraemia.
Middle duodenum.	About 50 cm.	No perit. Gallst. Pur. capill. bronch. Pale papilloma at lower limb of intest. disease.

fection. Later, the most generally accepted opinion has been that the disease arises from the invasion of the intestine by germs. A case described by HERTZ in 1936 — that of a 9-year old boy — showed that metastatic infection can take place. The cases indicative of a haematogenous aetiology are, however, much in the minority among the published cases, and it will always be possible to claim that an infection has taken place from the intestine. The advocates of this theory (DEUTELMOSE, UNGERMANN, FRISING and SJÖVALL, HELLSTRÖM and others) quote cases in support of it, and HERTZ has done so too. In the case recorded by TAYLOR and LAKIN, a phlegmon was found to start from a fish bone sticking in the mucosa. In a case recorded by FRISING and SJÖVALL, the fish bone found was, to be sure, loose in the intestine. In another of their cases a phlegmon was found around a diverticulum of the duodenum.

According to HERTZ, there are cases on record in which parasites were possibly to blame, trichocephalus in a case recorded by BUNDSCHUH and WOLFF, and oxyuris in FROMME's case in which numerous eosinophile cells were found in the infiltrated area. Trauma may also be responsible (MCCALLUM and ASKNAZY), but in both the cases cited, the interval between the trauma and the onset of the disease was one of several weeks.

The most natural assumption is that a lesion of the mucosa, due to some cause or other, forms the port of entry of virulent germs. Reliable evidence in support of this view is available only in the rare cases in which a foreign body is located in the mucosa of the affected area. MÜLLER (1914) carefully scrutinized eight well-known cases and came to the conclusion that they indicated infection from within the intestine. He found no evidence of a metastatic origin of the disease. If it is caused by an infection from the intestine, why are these malignant intestinal phlegmons so rare, and why do they show a preference for the upper portions of the small intestine?

While the virulence of germs and the powers of resistance of the body are assuredly of importance, we should do well to seek other factors such as the part played by HCl in the stomach. Achylia is associated with comparatively rapid emptying of the stomach. Lack of the disinfecting property of HCl is of particular importance to the highest sections of the intestine whose contents are normally more or less sterile. It is difficult to ascertain the degree of acidity of the gastric juice when patients are very



ill, as in my cases, and I examined only two in this respect. One was achylic, the other gave a faintly positive Congo reaction.

Gastritis was found in several cases already published, and HELLSTRÖM believes that the acidity of the gastric juice is often reduced. One would also expect this on account of the patients' age. In both the cases recorded by FRISING and SJÖVALL there was microscopic evidence of gastritis, and in cases recorded by three other observers it was macroscopically demonstrable. SCHNITLER refers to the great importance of anacidity to the genesis of phlegmonous gastritis. According to FABER, gastric secretion is diminished in about every other person over the age of 50 (SEIDELIN), and in a home for old folk MEULENGRACHT found achylia in 75 per cent. after the age of 70. Anacidity may well play a part in the development of phlegmonous jejunitis even though it may also occur under normal HCl conditions.

Pyogenic germs have been found in most cases. HELLSTRÖM says that among 19 cases there were 13 in which streptococci alone were found. In the remaining six they were found together with staphylococci, *B. coli* or proteus. In a few cases *B. coli* has been reported as a solitary finding (ORTH, TAYLOR and LAKIN).

Several cases have been recorded in which the phlegmonous process was multiple, not single, the intestine being healthy in between. Such multiple behaviour was observed in six of my cases. One is tempted to think of a haematogenous infection, but if this were so, the pathological-anatomical changes should be equally marked in all the parts involved. But this is not the case. The process usually diminishes both in length and intensity as it is traced downwards. This is so also when the process is uninterrupted, and it seems accordingly that infection from the intestine is the decisive factor, the primary seat of the infection being the upper portion of the diseased intestine whence the inflammation spreads downwards in its walls. When the disease occurs in several different places it may, perhaps, spread from the place first attacked through the lymphatic channels, reaching the regional glands in the mesentery and extending from them in retrograde fashion through the lymphatic channels to lower sections of the intestine. Such a possibility may account for the development of several isolated phlegmons and for the observation that their appearance is fresher the further they are traced downwards. According to another hypothesis, the disease begins with a phlegmon in the upper jejunum, causing secretion of

a toxic and virulent fluid into the intestine whose contents will, as they pass downwards, render the mucosa permeable for virulent germs with a consequent new phlegmon. Its appearance will therefore naturally be fresher than that of the highest phlegmon.

The fact that the upper part of the small intestine is fixed in place has been said to account for the localization of the disease in this position, but I have found no further elaboration of this theory. Yet it seems fairly plausible, and we may note that the proximal and terminal ends of the small intestine differ both anatomically and physiologically from the intermediate section. The contents of the duodenum and jejunum are normally more sterile than is the case further down in the intestine, and their resistance to infection is therefore comparatively low. The terminal end of the small intestine is peculiar in being the seat of a physiological stagnation of its highly infected contents. We can at any rate say that both the proximal and terminal ends of the small intestine present conditions peculiar to themselves.

With regard to the anatomy of the small intestine, it should be noted that Kerkring's valves begin a little below the pylorus, but are not well marked before Vater's papilla is reached. From this point downwards through the duodenum they are large and close together till the lower half of the jejunum is reached. Here they begin to dwindle, and they disappear completely some way down the ileum. It is precisely here, where these valves are most developed, that the severe processes of phlegmonous jejunitis tend to develop. It seems natural that a section of the intestine with large folds and deep crypts may be less resistant to trauma and infection than a more smooth-walled intestine. The objection may at once be raised that the lower ileum is the seat of the terminal ileitis which is more frequent than phlegmonous jejunitis. But special conditions may be operative at this point also.

The diarrhoea so common in my material must surely be regarded as a manifestation of the disease and not as a cause of it. When, as sometimes happens, there is no diarrhoea, this may be so because the local enteritis is not well marked or because the contents of the intestine are retained there, are vomited up, or the water in them is reabsorbed lower down in the intestine. Faecal vomiting is not rare, and there is almost certainly paresis of the muscles of the diseased section of the intestine.

Like earlier writers I have come to the conclusion that most of these phlegmons of the jejunum are due to an infection from the

intestine with virulent germs penetrating its walls through some flaw in the mucosa. Predisposing factors are the anatomical and physiological characteristics of the duodenum and jejunum. Achylia comes next as a causal factor and, of less importance, a pre-existing enteritis. A metastatic process may occur, but is assuredly very rare if we disregard the multiple abscesses of a pyaemia.

The explanation just given may seem unconvincing by itself, for if there were no other factors of importance, these phlegmons would be much more common than they appear to be, particularly as neither achylia nor enteritis, for example, is absolutely essential to their development. Further, pyogenic germs and probably also small lesions of the mucosa are of daily occurrence. Hence the suspicion that there are other, unknown predisposing factors such as the functioning of intestinal secretion, vitamin deficiency, lowered local resistance etc. We must also admit ignorance of the frequency of this disease, particularly the light forms of phlegmonous jejunitis whose aetiology is presumably the same as that of the severe form. The light forms are certainly very seldom recognized.

### Acute Phlegmonous Jejunitis (Light Cases).

While studying the severe form of the disease, I wondered why I encountered only severe cases. I soon noticed that, with this in mind, one can find light cases which end in recovery without any treatment and which are overlooked unless they are sought for specifically. Our most important aids to diagnosis are a radiological examination and an exploratory laparotomy. Hitherto there have been three such cases in the Bergen City Hospital, and Dr AARS NICOLAYSEN has kindly let me publish two of his cases.

As I can find no description of the clinical features of this condition as a disease *sui generis*, I propose to deal with it in some detail. It is evidently not quite rare, and it has probably often masqueraded in annual hospital reports under the heading, "colic". Two cases follow.

*A man, M. F. aged 29*, was admitted to the Epidemiological Department with the queries: Gastro-enteritis? Typhoid? Four days later he was transferred to the Surgical Department. He had fallen ill three days before admission to hospital with a sense of abdominal distension,

general malaise and pain above and about the umbilicus. Two days later his stools had become frequent, watery and stinking. Temperature 38 on admission to hospital. He did not seem to be exhausted. Meteorism with slight tenderness on pressure over the epigastrium. No rigidity nor distension. Intestinal sounds normal. His symptoms disappeared rapidly under dietetic treatment, and he was up and about after the second week in hospital, though his temperature was subfebrile throughout the first month. Leucocytes 11,400. Differential count: eosinophiles 2 %, young forms 1.5 %, band forms 14.5 %, polymorphs 48 %, lymphocytes 33 %, monocytes 1 %. Blood sedimentation rate 36 mm. Tests for typhoid, paratyphoid and dysentery negative. Highest diastase in urine 32. Urobilin 1/40 +. Benzidin in stools constantly positive. Ewald Congo + HCl/TA: 56/92. On admission to hospital a radiological examination showed that after a test meal had traversed the stomach, it began at once to fill a large-calibred coil of jejunum lying in an approximately circular position below and to the left of the stomach. After this coil had become filled it measured 18 cm. in diameter from above downwards. After 3, 24, 48 and 72 hours there was still some barium in this coil whose outlines were irregular and calibre about 5 cm. The emptying of the intestine proceeded unhindered. The marked dilatation and the circular shape assumed by this coil might indicate a relative obstruction at the distal end, but they might also be indicative of rigidity of the intestinal wall as seen in jejunitis. (Fig. 2 a and 2 b.)

Under spinal anaesthesia, an *exploratory laparotomy* was performed through a left-sided, diarectal incision above the umbilicus. The first coils of small intestine seen were perfectly normal, and they were still so when followed down to the caecum. But considerable changes were found in the jejunum. From the flexure and for 30 cm. downwards, the intestine was injected, oedematous, and definitely thickened. The injection, which was somewhat greater at the attachment of the intestine to the mesentery, extended downwards on the mesentery. Comparatively firm and enlarged glands could be felt in the mesentery. This process was plainly most marked at its highest point, and it diminished when traced downwards, merging gradually into normal intestine. The section of intestine involved was slightly dilated and somewhat stiffer than normal. A coil of intestine was quite lightly compressed by adhesions, but not enough to interfere with the passage of its contents. No other morbid changes in the abdomen in which there was no definite increase of free fluid although the intestines were somewhat more moist than normal. A couple of glands were removed for examination and the abdomen was closed. Culture from the interior of the glands yielded haemolytic staphylococci but no tubercle bacilli. A microscopic examination of the glands showed reactive changes. Cultures from throat and nose yielded staphylococci, and from the duodenal juice *B. coli* in pure culture. Blood culture negative.

A month after admission to hospital, a radiological examination showed very definite changes corresponding to the upper jejunum, but they were slighter than on admission. Two-and-a-half months after admission, he said he felt perfectly well. Benzidin in stools negative.

A radiological examination showed some irregularity of the relief of the upper coils of the jejunum as well as some irregularity of filling. The upper coils of the intestine, situated immediately under the stomach, were rather slow in emptying, although nothing of the contrast meal could be seen in the intestine after three hours. Radiological diagnosis: Remains of an acute jejunitis.

*K. T. Woman aged 69.* On the day before admission she fell ill with abdominal pain, vomiting and intestinal obstruction. On admission, abdomen somewhat rigid, slight resistance and tenderness in the epigastrium being most marked to the right of the middle line. Slight jaundice was taken at first to indicate cholecystitis. A comprehensive radiological examination showed distended coils of small intestine in the upper part of the abdomen with fluid level. The lower abdomen also showed a fluid level. Ileus diagnosed both before and on admission to hospital. We began to suspect jejunitis, and after one and three hours respectively a contrast meal was seen to be distributed in considerably dilated and atonic coils of small intestine. After ten hours the contrast meal occupied the same coils which had dilated still more. Numerous fluid levels. Diagnosis: Obstructed small intestine passage, paralytic ileus. We started treatment with penicillin and introduced a Miller-Abbott tube which reached to 1.5 m. from the pylorus, and through which large quantities of faecal fluid were evacuated. Under simultaneous intravenous injection of fluid she rallied quickly, and after three days the tube could be dispensed with. With the restoration of the passage of the contents of the intestine she improved rapidly, and when a serial radiological examination of the intestine was undertaken barely three weeks after admission to hospital, the relief of the mucosa of the upper coils of the jejunum, was, perhaps, rougher than normal, and this was particularly noticeable in the lower part of the small intestine. The terminal coil of ileum showed spasm and an unbroken column of the test meal with large and irregularly shaped folds of the mucosa. Ileitis was diagnosed, and when she was discharged soon afterwards she felt perfectly well and has remained so since.

This case, which I hesitate in describing as light or severe, shows how difficult the diagnosis may be. My inclusion of it among the light cases was determined by the general condition which was good as compared with that of the severe cases described. To judge by the radiological findings, most of the small intestine was involved, and it is conceivable that the primary lesion was situated in the lower portion of the ileum, the severity of the inflammation diminishing as the jejunum was traced upwards. If this were so, the correct term to be applied to this condition would be ileo-jejunitis. This point could not be decided as we did not feel called on to operate. Such a case of ileo-jejunitis is discussed in the section on ileitis. It will be noted that our employment of the Miller-Abbott tube was of crucial importance to the

recovery of this patient. The great importance of such continuous aspiration-drainage is also illustrated by the case recorded by E. BJÖRGO of a woman, aged 43, whose phlegmonous jejunitis was situated in the uppermost 100 cm. of the jejunum. This case certainly belonged to the class I have described as severe jejunitis. This patient recovered, and the diagnosis was confirmed by an exploratory laparotomy.

In another case, that of a man aged 51, the diagnosis was verified by operation and three months later a stricture of the jejunum had developed, necessitating resection.

It will be noted that in this form of jejunitis also its onset is acute, with pain in the left abdomen, or, at any rate, in the upper abdomen. Other manifestations are vomiting, impaired action of the bowels and fever. The illness began in the first two cases with diarrhoea, and there was a moderate leucocytosis with shift to the left and an increased sedimentation rate. In every case there were only slight abdominal signs limited to tenderness without rigidity. This clinical picture should suggest jejunitis, and a radiological examination with a barium meal should clinch the diagnosis. Such an examination is essential and can hardly be dangerous in these light forms; it will show delayed passage of the contents of the gut, dilatation of coils of small intestine with fluid levels and an irregular mucous membrane relief.

Treatment will primarily be dietetic, if need be supplemented by penicillin and the employment of a Miller-Abbott tube. From the strictly pathological-anatomical point of view, the two patients coming to operation presented a picture identical with that found in severe jejunitis. By themselves, the operation findings cannot differentiate between light and severe forms of the disease; it is its clinical behaviour which distinguishes one from the other.

The last case is of special interest as it shows that complications may occur in the form of strictures as so often recorded in cases of terminal ileitis. In this case the disease developed in the course of a couple of months, and this suggests the existence of a disease identical with regional ileitis except for its situation. The development of such a secondary stricture is assuredly very rare. At a meeting of the Swedish Surgical Association, Y. LARSSON has reported a case of multiple stenoses of the jejunum with a history dating back four years. After resection the patient was symptom-free for two years. This case was probably similar to one of terminal ileitis.

The light form of acute phlegmonous jejunitis might well be called jejunitis acuta simplex, and the term jejunitis acuta phlegmonosa, reserved for the severe form of the disease in the same way that STRÖMBECK has proposed a classification of terminal ileitis.

### **Ileitis Regionalis Acuta.**

During the last seven years, 14 patients suffering from this disease have been treated at the Bergen City Hospital. Two other cases, included in my study, have been treated by my colleagues. The ages of the 14 hospital patients ranged from 8 to 57 years, with an average age of 22 years, and the incidence highest in the age-group 11—20 years. Thirteen of the 14 were operated on with the diagnosis of acute appendicitis. The fourteenth patient had already been rid of her appendix, and the diagnosis at operation was ileus. This case differed from the rest in that the clinical picture was much more marked and resembled somewhat the picture already drawn of acute jejunitis. The whole of the ileum and a considerable part of the jejunum were involved, the intensity of the disease diminishing as it was traced upwards. In 12 cases the disease was strictly terminal, and in one of them the intestine was diseased at a slightly higher level also, conditions being normal between the two diseased areas. In one case the disease was situated about 25 cm. above the caecum. All these patients recovered. I have re-examined 11 of them, and in two have found evidence of intestinal disease without, however, any signs of stricture.

A patient of one of my colleagues, a woman aged 38, first underwent an operation for acute perforation of the appendix at the Bergen City Hospital. There was no macroscopic evidence of ileitis at the operation, but ten weeks later she was operated on at another hospital for ileus, and now a constricting chronic ileitis was found and necessitated resection.

In spite of the great interest taken in regional ileitis, particularly with regard to its aetiology, it has not yet been fully elucidated. There is much to suggest that the acute form which ends in rapid recovery is due to an infection from the intestine in the same way as is assumed to be the case in acute jejunitis. The disease is generally supposed to have nothing to do with the appendix, though the above-mentioned case leaves this possibility open.

In American publications attention has been focussed on

chronic ileitis with the formation of strictures. It is doubtful if the aetiology of constricting ileitis is identical with that of the acute and most common form of ileitis. At one time the constricting form was held to be tuberculous, but much microscopic research seems to have invalidated this view, although STRÖMBECK has shown how very difficult it may be to demonstrate the tuberculous character of a lesion; in one of his cases the microscopic picture alone was not convincing proof of tuberculosis which was not demonstrated till tubercle bacilli were cultivated. In acute, benign cases, ending rapidly in recovery without resection, tuberculosis can be excluded. In none of the 11 hospital patients re-examined from two to seven years after appendicectomy had any sign of abdominal tuberculosis developed.

The relationship of the constricting form of ileitis to acute regional ileitis is still obscure as it is also to lymphadenitis mesenterialis whose manifestations are apt to be interpreted as those of mild, acute appendicitis; an operation in such cases reveals only a little serous fluid and enlarged mesenteric glands presenting under the microscope an ordinary hyperplasia. As already pointed out by H. FR. HARBITZ, it would be natural to regard this condition as an abortive form of regional ileitis. STRÖMBECK also connects these two conditions with each other. If we assume that constricting chronic ileitis may be a sequel to an acute ileitis, it may also be so to a lymphadenitis mesenterialis, and it is obvious that such a "prodromal stage" will often be difficult to demonstrate without an operation. E. E. VUORI has reported on 100 cases of lymphadenitis mesenterialis in which tuberculosis could be excluded. Most of his patients were in the age-group 6—12 years. He suggested that the happy issue of these cases might indicate that the appendix was of aetiological importance in spite of negative histological findings. But one may object that just as many cases would presumably end in recovery without appendicectomy.

We are evidently still ignorant of the aetiology of regional ileitis. There are, however, many observations (at any rate in the acute form of the disease) linking it up with an infection from the gut as in acute jejunitis. Some small lesion of the mucosa may lead to lymphangitis with lymphadenitis which spreads in the submucosa. Lymph stasis may possibly favour the development of this condition. According to STRÖMBECK, the influence of lymph stasis is discussed by REICHERT and MATHES. Most observers seem to trace the disease to an infection from the gut.



According to ANDERSEN, NORDENTOFT has reported on a case of ileitis following an injury to the wall of the intestine by a thorn inside it. It is conceivable that spontaneous recovery from the acute form of the disease may be followed by relapse, but I can find no record of such a case.

In the chronic form of the disease, relapses have been known to follow resection (OSWALL, KALLIUS, GEJROT). Such an event neither invalidates nor supports the theory of infection from the gut, and it would be natural to interpret it as indicating the influence of special aetiological factors.

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### Summary.

The writer describes 21 cases of acute jejunitis and 16 cases of acute regional ileitis. He considers that it is the same complaint with different localisation. The stress has been put on acute jejunitis which in the opinion of the writer is more frequent than is generally supposed. In most cases one may arrive at a correct diagnosis, with the aid of radiological examination. Jejunitis may be divided into two forms, the jejunitis acuta phlegmonosa with heavy mortality, and a light mild form which the writer suggests should be called jejunitis acuta simplex. This last form is little known and may frequently be undiagnosed. Jejunitis may be followed by stricture which has often been described in the terminal part of ileum. The cause of the complaint mentioned, is supposed to be infection from the intestine with further spreading in submucosa or possibly through the lymphatic channels. Pyogenic microbes seem to be of importance.

In order to get a better understanding of the condition, the writer emphasises the use of bacteriological examination likewise the importance of follow-up-examination of the patient.

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## Splenic Tissue in the Scrotum.

By

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The most common development anomaly of the spleen is the appearance of one or more accessory spleens. The location of this accessory tissue varies, but the ectopic tissue is most frequently seen in a limited area near the hilus of the spleen proper.

Splenic tissue is extremely seldom encountered in areas remote from the main organ as in the scrotum adjoining testicle-epididymis-spermatic cord. Splenic tissue may be found here in the shape of a cord-like connection between the spleen proper and the remnants of the mesonephros or in the form of one or more accessory spleens. Such observations have probably often been made but not subjected to a close examination and therefore misinterpreted, with the consequence that they were not published either.

Fifteen cases with ectopic tissue in the scrotum are known to literature, to which one of my own may now be added. The character of the cases as the clinical, operational or autopsic findings and microscopical examination will be apparent from the following review.

1) BOSTRÖM demonstrated in 1883 at Freiburg at »Versammlung deutscher Naturforscher und Ärzte» (Bericht 56. Tagung, page 149) a case with a fusion between the spleen and the left testicle; the position of both organs was normal.

2) POMMER (Berichte d. naturwiss.-med. Vers. Innsbruck 1888/89, page 144) published an observation some years later of a male perobrachius apus with several abnormalities: left testicle and epididymis were located in the left fossa iliaca and were connected by a brownish-red cord to the inferior pole of the normally located spleen.

3) ROLLESTONE (according to ADAMI and NICHOLLS in "Principles of Pathology", 1911: II: 222) encountered a spleen with a lingulate continuation extending down into the scrotum.

4) SNEATH (*Journ. of Anat. and Physiol.*, 1913: 47: 340) published a case of a negro who, when clinically palpated, was believed to have a supernumerary testicle in the left half of the scrotum. — Autopsy revealed a cord extending from the superior pole of the spleen, through the abdominal cavity and the left inguinal canal to terminate in a swelling adhering to the upper pole of the left testicle. — Microscopic examination of the cord: splenic tissue.

5) HEITZMANN (*Centralbl. f. allg. Path. u. path. Anat.*, 1917: 28: 401) wrote of a case of a 25-year-old man with left, indirect inguinal hernia. — During the operation a bluish-red cord was revealed extending from the superior pole of the left testicle, then proximally through the open processus vaginalis peritonei into the abdominal cavity, whence it continued under the omentum and mesocolon transversum towards the posterior abdominal wall. — Microscopic examination of the cord: splenic tissue.

6) SKWORZOFF (*Virch. Arch. f. path. Anat.*, 1924: 250: 636) discovered an analogous case in a 10-year-old boy. — Autopsy showed the spleen to be in normal position, whilst the scrotum was empty. From the inferior pole of the spleen there extended a cord through the left half of the abdominal cavity to the internal opening of the left inguinal canal where it joined the spermatic cord and, like a connective tissue, encased the left testicle located at the external opening of the inguinal canal. — Microscopic examination of the cord: superior two thirds consisted of splenic tissue, inferior third, connective tissue.

7) TALMANN (*Virch. Arch. f. path. Anat.*, 1926: 259: 237) had a patient, a 22-year-old man, who subsequent to an attack of malaria, was troubled by a swelling in the left half of the scrotum. — The operation disclosed a hazel-nut sized swelling in the head of the epididymis, and high up in the spermatic cord was another swelling the size of a pea. — Microscopic examination of the swellings (accessory spleens): splenic tissue.

8) FINALY (*Nederl. Tijds. v. Geneesk.*, 1926: 70: 397) discovered in a newborn child with left congenital inguinal hernia that the left "testicle" was twice as large as the right. — The operation disclosed an open processus vaginalis peritonei with the left testicle in the hernial sac, and at the head of the left epididymis was a bean-sized lump covered with peritoneum without any cord-like growth extending towards the abdominal cavity. — Microscopic examination of the swellings (accessory spleens): splenic tissue.

9) OSELLADORE (*Riforma Medica*, 1928: 44: 1469) described a 19-year-old youth who had had some small lumps in the left half of the scrotum since birth. — An operation revealed the presence of small, multiple accessory spleens on the left testicle.

10) FISCHER and GISSEL (Brun's Beitr. z. klin. Chir., 1935: 161: 595) published a case of a 13-year-old boy with double cryptorchism. — An operation disclosed a cord ascending from the left epididymis into the left side of the abdominal cavity. — Microscopic examination of the cord: splenic tissue.

11) SETTLE (Amer. Journ. of Surg., 1940: 50: 22) had a case similar to TALMANN's (Nr. 7) in which the patient was troubled by a swelling of the left half of the scrotum during the acute, febrile phases of tertian malaria. — An operation disclosed an enlarged accessory spleen in the scrotum.

12) EMMETT and DREYFUSS (Annals of Surgery, 1943: 117: 754), had a case, a 47-year-old man, with a double, indirect inguinal hernia who, when clinically examined, was found to have a swelling at the upper pole of the left testicle. — When operating one found a brownish-red, encapsulated tumour as large as half a testicle firmly attached to the head of the epididymis. — Microscopic examination of the tumour (accessory spleen): splenic tissue.

13) KADLIC (Zentralbl. f. allg. Path. u. path. Anat., 1943: 81: 49) palpated a lump as large as a fist in a left scrotal hernia of a 19-year-old youth. — An operation revealed a tumour which was connected to the upper pole of the left testicle by means of a short cord and tapered off cranially to a stem that ascended through the left inguinal canal towards the left hypochondrium. — Microscopic examination of the cord: splenic tissue.

14) OLKEN (Amer. Journ. of Path., 1945: 21: 81) carried out a post-mortem examination of a 56-year-old man and found that from the spleen there extended along the left lateral wall of the abdomen a cord that joined the spermatic cord in the left internal inguinal ring, passed through the inguinal canal and terminated in the form of a bulbous tumour-like mass which lay close to the head of the left epididymis. — Microscopic examination of the cord: splenic tissue.

15) ANDREWS and ETTER (Journ. of Urol., 1946: 55: 545) observed a swollen "spermatic" cord in a 32-year-old man who had been admitted to hospital on account of pains in the left half of the scrotum. — An operation revealed a bluish cord extending from the left external inguinal ring to the left testicle. — Microscopic examination of the cord: splenic tissue.

16) Report of case. Surg. Clin. Case 3248/37, K. A. — During medical inspection of school children, a 9-year-old boy was found to have a swelling posterior to the testicle in the left half of the scrotum. — When operating (H. B. WULFF) one found a walnut-sized, darkbrown tumour at the inferior end of the left testicle. — Microscopic examination of the tumour (accessory spleen): splenic tissue.

All these cases exhibit an essentially similar anatomic finding. In ten cases (1, 2, 3, 4, 5, 6, 10, 13, 14 and 15) a cordlike growth was found extending from one of the splenic poles and terminating in most cases in a small protuberance; in six cases (7, 8, 9, 11, 12 and 16) the findings consisted of accessory spleens. One feature common to all these observations is the fact that the splenic tissue in the scrotum adheres to that region where the remnants of the cranial portion of the mesonephros (wolffian body) are to be sought.

In order to explain the formal genesis of this rare anomaly it is necessary to know the conditions of development from the fifth up to the eighth week of fetal life. The spleen is developed in the dorsal mesogastrium where it is first discernible in the shape of a localized growth in the fifth week and is generally fully developed in form in the twelfth week. The mesonephros reaches its maximal cephalad extension in the fifth week after which it retrogrades in the cranial portion.

A condition for the occurrence of the above anomaly is a fusion between the splenic anlage and the mesonephric fold. The initial teratogenetic period of this fusion is the fourth or fifth week of fetal life, when the mesonephros has acquired maximum size and the splenic anlage begins to differentiate. The teratogenetic termination period must be considered as lying somewhere between the eighth and tenth week, when the genital glands begin their caudal migration. It is probably between the seventh and eighth week that the anomaly arises, when there exists a well developed spleen tissue on one hand and on the other, a pronounced plastic transformation of the spleen. The underlying cause of the fusion between the splenic anlage and the mesonephros is unknown.

If the splenic anlage is in close contact with the mesonephros it must also take part in the retrogression of the cranial pole of the wolffian body, which is in turn bound to the caudal migration of the testicles. As this migration of mesonephros and testicle is retroperitoneal, whilst the spleen retains its intraperitoneal position, a free cord running through the abdominal cavity to the left mesonephros must generally be, so to say, spun from one of the splenic poles. This cord-like growth is stretched and then elongated in the latter weeks of intrauterine life during the final migration of the genital glands through the inguinal canal down into the scrotum.

In such cases it is almost impossible to make a correct pre-

operative diagnosis. One might, however, assert that in such cases as have had a long-existing tumefaction in the left half of the scrotum, especially with a simultaneous left, indirect inguinal hernia, the possibility of ectopic splenic tissue should be considered when performing the already difficult task of making a differential diagnosis of tumours in the scrotum.

Thus whilst accessory splenic tissue in the scrotum may be considered more or less as a medical curiosity, it is of interest not only to the embryologist and the pathologist but can also offer clinicians a diagnostically interesting problem when interpreting an inexplicable swelling in the scrotum.

### Summary.

With reference to a case with ectopic splenic tissue in the left half of the scrotum, the author cites earlier publications (15 cases) and discusses the genesis of this anomaly. In the differential diagnosis of tumours in the left half of the scrotum the possible existence of such accessory splenic tissue ought to be borne in mind.

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## Surgical Treatment of Essential Hypertension.

By

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In the publications concerning the results of surgical treatment of hypertension there is general agreement on the fact that the effect on the subjective discomforts of the patients is amazingly good. The cardiac and cerebral symptoms improve in such a degree that there not infrequently seems to be a considerable discrepancy between this subjective improvement and the postoperative decrease of the blood pressure, so that the patient is more satisfied than the surgeon.

### Material and Methods.

The material consists of 41 cases which are controlled during 1—5 years after the operation. The clinical status seems after a year to be stabilized to such a degree that it may be considered as a lasting result.

In this, as in other materials of hypertensive disease, the females are in majority. I shall not here enter into pathogenetic problems, but only call attention to the fact that only in 3 females (1, 15, 21) the records give information of pathogenetic value as their disease has appeared after a serious pregnancy intoxication.

Average age has been 45.3 years. 9 cases have been over 50 years (14, 15, 18, 19, 20, 23, 30, 32, 34) the age that in the literature often is stated as the limit age for operative procedures in this disease. Two cases are dead during the observation time. There has been no operative mortality. It would have been of great importance to determine the duration of the disease and compare this time factor with the anatomical findings in the

kidneys and with the results of the treatment. This cannot exactly be done as the greater part of the cases for years have presented subjective symptoms before having had the diagnosis verified. These subjective discomforts have in 21 cases been of essential cerebral nature, in the rest cardiac symptoms have been predominant. The duration of these symptoms has varied from 1 to 16 years.

Roentgenological findings of enlarged heart and electrocardiographic signs of hypertrophy of the left ventricle have been present in all patients. None of them have shown symptoms of considerably reduced renal function. Sclerotic changes in the arteries were not to be found by clinical and roentgenological examination. Direct observation of the blood vessels in the eyeground have in 30 cases revealed vascular changes characterizing a hypertonic fundus, without marked papillitic and retinitic changes. The arteriolar findings in the kidneys will be discussed later.

The material has been treated surgically after a modified Smithwick's method, namely supra- and infradiaphragmatic resection of the splanchnic nerves and removal of the sympathetic chain from 9. Th. to 2. L. ganglion. In addition hereto is the celiac ganglion removed. The first step in the operative procedure has been exploration of the kidney. Biopsy specimen from this organ is controlled in 38 cases. In the patients where the renal capsule was found tight and thickened a decapsulation was made. The therapeutic reasoning for this procedure is the investigations of GRAEF and PAGE (1940). In order to exclude the collateral circulation they deposited cellophan around the kidneys. That produced a constrictive perinephritis that without affecting the renal hilus effected a permanent hypertension in the animals.

The operation has been performed on both sides at an interval of 3—4 weeks and in spinal anesthesia. Some patients have mentioned pain when n. splanchnicus maj. is sected in the thorax. This can be eliminated by injection of a local anestheticum in the nerve. Lesion of the pleura has seldom occurred and has produced no postoperative complications when the air in the pleura has been exsufflated immediately after the operation.

## Results.

Length of lifetime, an important factor in the judge of the therapeutic results is unknown for the greater part of the ma-

terial. A norwegian statistic of hypertensive patients (RASMUSSEN) admitted in hospital and treated medically demonstrates that one third of them dies in the following 3 years. It is obvious that the mortality in this not specially selected operated material will not be so high.

The changes in blood pressure are shown in tab. I. Here is to be remembered that the average age of the patients is 45 years so that a blood pressure up to 140/90 is appointed not to be pathological. Eight cases (4, 13, 17, 21, 22, 28, 36, 31) have shown a pressure lying on or below this level. 16 cases present a fall in systolic pressure from 60 to 110 mm. Hg. and 7 cases a fall from 30 to 55 mm. The rest, 10 cases, shows very little or no reduction, but only three of them have had a pressure exceeding the preoperative level. 33 cases have had signs of postural hypotension immediately after the operation. These symptoms have disappeared at increasing blood pressure. After 6—12 months the pressure seems to be stabilized at a level that has been amazingly constant during the following time of observation.

In trying to define the indications for surgical therapy in hypertensive patients their vasomotor reactions to different stimuli such as sodium nitrite and amytal are controlled. The value of these tests in prognosticating the effect of sympathectomy is according to our experience limited. The material seems to show, however, that if administration of nitrite does not lower the systolic pressure 50 mm. Hg. or more, and the diastolic pressure to 120—125 mm. Hg. the case as to a permanent decrease in blood pressure will hardly show satisfactory results of an operative procedure. Here is to be remembered that the sympathectomy as a rule brings about a greater immediate reduction of blood pressure than these pharmaca. These tests can, however, be adjuvant in determining relative contraindications for operative therapy without being any reliable prognosticum for the single operated patient. It is therefore reasonable to give them a place in the preoperative examinations of the patients in addition to the determination of the night or rest pressure.

The effect of the operative procedure on the heart is controlled by roentgenological, and electrocardiographic measures. The size of the hypertrophic heart normalizes in a couple of months in the patients getting a normal or greatly reduced pressure, and under the same conditions disappear the electrocardiographic signs of enlargements of the left ventricle.

No.	Age	Sex	Dur. years	Cor	Art. sel.	Renal funet.	Eye-ground.	Subj. compl.
1	E. B. 43	Fem.	5	L. ventr. hypertr.	÷	<sup>+</sup> Ur. cl. 68	Art. narrow. Art.-ven. compress.	Cerebr.
2	E. F. 48	—	5	+	÷	74	+	—
3	P. B. 44	—	10	+	÷	63	+	Cardial
4	B. P. 35	M.	2	+	÷	66	—	Cerebr.
5	E. R. 45	Fem.	9	+	÷	68 (Protein +)	+	—
6	A. B. 45	—	2	+	÷	60	+	Cardial
7	T. R. 53	M.	12	+	÷	72 (Renal calc.)	+	—
8	K. B. 49	—	7	+	÷	78	+	—
9	I. N. 36	Fem.	2	+	÷	84	+	Cerebr. Cerebr.
10	H. H. 41	—	2	+	÷	70 (Protein +)	+	(+ card.)
11	R. N. 44	—	8	+	÷	66	+	Cerebr.
12	O. J. 48	M.	4	+	÷	83	+	Cardial
13	A. S. 43	Fem.	4	+	÷	72	+	Cerebr.
14	S. H. 54	—	9	+	÷	68	+	—
15	K. G. 53	—	18	+	÷	60 (Protein +)	+	Cardial
16	I. L. 42	—	8	+	÷	64	+	Cerebr.
17	O. H. 35	M.	1	Sl. +	÷	84 (Protein +)	+	Cardial
18	R. N. 52	Fem.	10	+	÷	70 (Protein +)	+	Cerebr.
19	A. P. 51	—	16	+	÷	62 (Protein +)	+	—
20	A. L. 50	M.	3	+	÷	65	+	Cardial
21	O. D. 35	Fem.	3	+	÷	78	+	Cerebr.
22	T. D. 41	M.	2	+	÷	83	+	—
23	K. J. 53	—	15	+	÷ (Sl. +)	76	+	—
24	J. K. 44	Fem.	8	+	÷	79	+	Cardial
25	C. V. 48	—	4	+	÷	86	+	—
26	V. R. 38	—	3	+	÷	78	+	—

## I.

B. P. at admiss.	B. P. Nitrite.	B. P. Amytal.	B. P. Rest.	Obs. time years	B. P. last control.	Kidney biopsy.	Postur. hypotens.	Effect on subj. sympt
215/135	135/110	160/115	160/110	3	155/110	0	+	Fair
220/130	135/90	160/110	170/115	3 $\frac{3}{4}$	160/110	1	+	Fair
210/120	150/120	160/120	180/120	3 $\frac{1}{2}$	185/120	1	+	»
240/130	150/90	160/105	175/100	3 $\frac{1}{4}$	135/90	0	+	Excellent
260/150	180/110	210/125	215/110	3 $\frac{1}{2}$	190/120	1	÷	Fair
210/130	165/90	180/110	195/115	4	150/95	0	+	Excellent
270/130	160/110	175/120	210/110	1	160/120	1	+	Fair
240/130	160/115	160/110	175/110	3	185/120	2	+	»
220/160	165/110	170/115		3	160/100	1	+	»
220/130	160/110			3	155/95		+	»
250/130	180/120	190/120	200/120	3 $\frac{3}{4}$	160/100	0	+	»
280/150	280/150			3 $\frac{1}{4}$	200/110		+	»
240/130	140/80	130/80	155/95	3	140/90	0	+	Excellent
250/140	190/120	190/120	210/120	3 $\frac{3}{4}$	195/120	1	÷	Unchanged
200/110	170/100	175/100	190/100	2 $\frac{1}{2}$	160/110	2	+	Fair
235/130	160/100	175/100	200/130	3	155/100	0	+	»
225/140	145/100	160/110	180/130	2 $\frac{3}{4}$	130/80	0	+	Excellent
210/120	180/120	180/120	190/120	3 $\frac{1}{4}$	230/120	2	÷	Unchanged
275/155	215/125	210/130	225/140	3	180/110	1	+	Fair
250/160	160/95	170/100	190/115	3 $\frac{1}{2}$	180/110	1	+	»
200/110	150/90	165/100	170/100	4	140/90	0	+	Excellent
200/100	130/80	150/90	160/95	4 $\frac{1}{2}$	140/90	1	+	Fair
220/130	170/110	175/120	190/120	4 $\frac{3}{4}$	180/110	1	÷	»
240/130	165/100	180/110	190/110	5	170/110	1	+	»
205/125	160/105	160/110	185/115	4	220/120	2	+	Unchanged
220/135	155/95	170/110	180/120	5	150/95	1	+	Fair

No.	Age	Sex	Dur. years	Cor	Art. scl.	Renal funct.	Eye-ground.	Subj. compl.
27	R. C. 46	—	4	+	÷	74	+	Cerebr.
28	R. P. 43	—	6	+	÷	69	+	Cardial
29	P. K. 41	—	3	+	÷	80	+	—
30	K. I. 53	—	9	+	÷	(Protein +) 62	+	—
31	E. K. 35	Fem.	2	L. ventr. hypertr.	÷	Ur. cl. 82	Art. narrow. Art.-ven. compress.	Cardial
32	L. R. 38	—	8	+	÷	74	+	Cerebr.
33	P. R. 48	M.	6	+	÷	68	+	Cardial
34	S. V. 52	—	12	+	÷	64	+	—
35	T. K. 42	Fem.	4	+	÷	78	+	Cerebr.
36	F. B. 38	—	3	+	÷	82	+	Cardial
37	R. L. 48	—	11	+	÷	70	+	—
38	S. P. 50	—	10	+	÷	64	+	—
39	A. V. 46	M.	3	+	÷	68	+	Cerebr.
40	E. K. 49	—	6	+	÷	70	+	—
41	I. F. 48	—	5	+	÷	82	+	—

The arteriolar changes are controlled in the eyegrounds and by kidney biopsies. As earlier reported were the alterations of the blood vessels in the eyegrounds preoperatively so moderate that any improvement has been difficult to demonstrate. The histological features of the kidney biopsies have been controlled in order to estimate their prognostic value.

In 10 cases (24.4 per cent) of the material are the histological pictures normal or show a slight hypertrophy of the muscle fibers in the tunica media of the arterioles, a finding that scarcely is to be characterized as abnormal in this age group. In the tab. I, they are given the number 0. 10 cases showed marked renal changes such as proliferation and even necrosis of the intima of the arterioles not seldom accompanied by exudate in Bowmanns capsule, and they are marked in the tab. by number 1. The rest, marked

I (cont.).

B. P. at admiss.	B. P. Nitrite.	B. P. Amytal.	B. P. Rest.	Obs. time years	B. P. last control.	Kidney biopsy.	Postur. hypotens.	Effect on subj. sympt.
230/140	165/110	180/120	180/130	4	160/100	0	+	Excellent
200/130	145/100	160/110	175/120	2 $\frac{3}{4}$	140/80	1	+	"
250/140	175/120	185/120	200/120	4	235/120	2	÷	Unchanged
240/130	180/120	175/120	195/120	3 $\frac{3}{4}$	220/120	2	÷	"
215/120	155/110	170/110	160/110	2 $\frac{3}{4}$	135/90	0	+	Excellent
225/140	170/130	180/140	170/120	2	200/110	2	+	Fair
240/130	180/120	190/130	200/120	1 $\frac{1}{2}$	220/110	2	÷	Unchanged
200/140	160/110	170/120	170/115	1	180/100	2	+	Fair
210/120	155/100	170/100	160/100	1 $\frac{3}{4}$	150/100	1	+	Excellent
200/110	140/90	150/100	160/100	1	140/90	1	+	"
230/130	190/130	200/130	200/130	1 $\frac{1}{4}$	240/130	2	÷	Unchanged
240/140	170/120	180/120	180/130	1	200/110	2	+	Fair
205/150	160/120	170/120	165/120	2 $\frac{1}{4}$	190/110	1	+	"
225/140	170/120	165/120		1 $\frac{1}{2}$	180/110		+	"
200/130	155/100	155/110		1 $\frac{3}{4}$	150/100	1	+	Excellent

as number 2, also showed pathological changes in the glomerular vessels and regressive changes of the epithelial cells of the contorted tubules. This group of the material reacted as a whole less satisfactorily on the operative therapy in comparison with the first group where the best results were to be found. It seems thus, with some exceptions, to be a distinct accordance between the morphological changes in the kidneys and the degree of post-operative decrease in blood pressure. In the operative procedure it seems therefore to be likely at first to explore the kidney and if it shows macroscopic or considerable microscopic changes that can be supposed to be bilateral, the operation may be confined to an exploratory incision if not severe subjective symptoms, such as unbearable headache, indicate sympathectomy.

The group of patients with hypertension and no or moderate

changes in the renal arterioles give a hint as to the pathogenetic problems of this disease. It is general agreement in recognizing increased resistance in the arterioles as the main mechanical factor in hypertensive disease, though it is still under discussion whether this factor is based on functional or anatomical alterations. SMITHWICK and CASTLEMAN (1943) found in more than half of their cases that the renal changes were inadequate to be the sole factor in producing the hypertension. In this material it seems likely to suppose the pathological findings in the kidney arterioles to be a pathogenetic factor of secondary nature. Renal arteriolosclerosis and hypertension may according to this be independent processes in the earlier stage of their development. In the further course these factors will constitute a vicious circle as shown in this material where the renal alterations seem to have a certain relation to the duration of the disease and in some degree to the height of the blood pressure.

A question of great clinical and histological importance is whether marked arteriolar changes in the kidneys may be reversible. The kidney specimens in the two patients that have died elucidate in some way this problem as both of them during the two years after the operations had a greatly reduced pressure, and the biopsies taken at the operation showed distinct, although moderate, arteriolar changes. The autopsy specimens showed, however, no signs of improvement of the renal changes.

These findings in addition to the fact that young patients with short morbid history give the most satisfactory results of surgical therapy support the claim of early operation in this disease. The indications should therefore be very simple as all cases of diagnosed manifest hypertension are to be examined regarding the possibility of operative treatment. Contraindications of relative degree to surgical intervention are with some modifications the same as found in literature. Though the limit of age is to be lowered to 40 or 45 years and the blood pressure ought not to be completely fixed. An absolute contraindication as measured of the therapeutic effect on the blood pressure is considerable bilateral histological alterations in the kidneys.

In spite of the fact that the surgical treatment of essential hypertension for the greater part has an empiric base the results of this symptomatic therapy is encouraging and exceed the medical treatment by far in effectivity. It is therefore reasonable to advise the hypertensive patient this, little dangerous, surgical



procedure as long as the pathogenesis of the disease is unknown and causal treatment therefore is not available.

If the effect of sympathectomy on the blood pressure in some cases is disappointing it must be borne in mind that the hypertensive disease from the patient's point of view often not is to be measured in mm. mercury.

### Summary.

1. 41 cases of essential hypertension, blood pressure 200/110—280/150 treated with bilateral sympathectomy are reported. After a postoperative observation time of 1—5 years 8 pat. have a normal pressure, 16 cases have a fall in systolic pressure of 60—110 mm. mercury, 7 cases a decrease of 30—55 mm. and 10 cases little or no decrease. 80 per cent of the patients are subjectively improved. 2 pat. have died, one of them by an accident.

2. Histopathological alterations in the kidneys are found in 75 per cent of the material. These changes have in two cases, controlled by autopsy, been irreversible in spite of greatly reduced postoperative pressure.

3. Renal arteriolosclerosis and hypertension seem to be independent processes in the earlier stage of their development.

4. The effect of the operative treatment on the blood pressure is most satisfactory in young patients with short lasting symptoms. This fact and the irreversibility of renal changes indicate early operation for this disease.

5. Contraindications are fixed blood pressure and distinct bilateral renal arteriolosclerosis.

6. In the very beginning of the operation the kidney (and adrenals) is to be explored. In case of considerable kidney alterations the operation is to be confined to this procedure if not certain unbearable subjective symptoms indicate sympathectomy.

### Literature.

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## Two Operatively Treated Cases of Hemangioma of the Liver.

By

PAUL ALSÉN.

Hepatic hemangioma of such a size that the growth occasions discomfort and the case comes to operation is a rare disease. According to HARRIS B. SCHUMACKER only 67 cases had been published up to 1942 and in no instance had any author had more than a single case. Having myself had the opportunity of operating two cases I consider it justifiable to present a report of them.

The first case was that of a woman aged 63 who was admitted to the hospital November 27, 1943. She had in 1916 been operated for stomach ulcer at a private clinic in Gothenburg. In 1931—1932 she was for 7 months treated at Svenshögens Sanatorium for pulmonary tuberculosis. At the latest pulmonary X-ray at the Central Dispensary she was said to have been pronounced cured. — Subsequent to the operation in 1916 the patient's stomach troubles continued for several years but following the sanatorium treatment these disappeared and she was free from symptoms until two months prior to admission. At this time she following the ingestion of greasy and of fried foods began to have hot flashes over the entire body and tremor of the hands, but there was no abdominal pain, no nausea or vomiting, and no icterus. Stools were sluggish and not especially light in color. The urination was normal. — X-ray at the policlinic November 22 showed enlargement of the liver and stasis gallbladder. Chest: Old tuberculous changes at center and base of left lung. The heart was of normal size and shape.

*Status on admission.* General condition not deteriorated. Normal adiposity and musculature. Heart: Sounds dull, rhythm regular. Blood pressure: 150/80. Lungs: Râles at base. Abdomen: Soft. Liver palpable two fingers' breadth below the costal margin, slightly tender. Per rectum: On palpation nothing pathological. Hb. 90 %, red cell count 4,460,000, index 1.02, white cell count 5,800, polymorphonuclears 3.6, monocytes 2.2, Meulengracht 1:6, Heijman v. d. Bergh direct:

negative, indirect: negative. Sedimentation rate 7. Gastric juice test 0 reaction. Test breakfast: Kongo & Uffelmann negative. Total acid: 8. Urinalysis: 0.

<sup>12</sup>/<sub>3</sub> Operation. Spinal anesthesia 19 c. c. of pereinine, deep anesthesia, pressure prior to operation 125, lowest level 50, post-operative 105. — Median rectus sheath incision. — The tumor which on palpation was interpreted as a dilated gallbladder was found to be a large cystlike growth, widely adherent and imbedded in the right hepatic lobe. The surface was coarsely lobulated and flecked with red. The entire upper surface of the gallbladder was adherent to the lower portion of the tumor, which was dissected free from below with careful ligation of the many and rather large vessels. The gallbladder, which first was dissected free, was slightly larger than normal and not remarkable and was not removed. In the lower portion of the right hepatic lobe a deep-seated tumor of the same type, the size of a hazel nut, was observed but was not removed. The ductus choledochus was wide but the biliary ducts felt normal and without concretions; a small gland was palpated in the lig. hepatoduodenale. — The bed of the tumor which did not bleed essentially was sutured and the gallbladder sutured to it. Drainage to the liver was instituted and closure done.

*Specimen.* The tumor measured 11 × 13 cm. and weighed 400 gm. The section showed a gelatinous center the size of an egg, surrounded by hemangioma-like tissue.

*P. a. d.* A large cavernous angioma with absence of malignancy.

The post-operative course was without complications and the maximum temperature — the day following operation — 39.3° C. The patient was ambulant on the 12th day and was discharged healed and well 12/20.

At examination <sup>12</sup>/<sub>7</sub>, 1946 the patient had herpes zoster; she reported that she had been free from symptoms since the operation. On palpation of the abdomen and per rectum nothing pathological was observed.

The second case was that of a married woman aged 58 who was admitted to the hospital February 10 1947. The patient was a para XI, 0 abortions. Menopause at the age of 45. In 1943 rheumatic pains in the left arm but the patient had essentially been healthy, excepting for a left-sided inguinal hernia of 15 years standing, only appearing on overexertion. — She had for the last 6 months observed a firm mass in the stomach, which shifted about on her changing position; — lying on the left side it was felt to the left and in the reverse position it was felt to the right. It had occasioned pressure and a sensation of discomfort in the stomach but had never occasioned pains nor had it been tender. The patient had not observed whether or not it had increased in size. Her appetite had been good and she had been able to eat all kinds of food and had not lost weight. — At the end of December 1946 the patient had a "cold" with fever and muscular pains and remained in bed for 3 days. About a week later she was again taken ill with symptoms of influenza, generalized muscular pains, fever, coughing, sore throat and vomiting. She had since this not recovered but had felt tired and had had a poor appetite and had now probably lost weight.



Fig. 1.

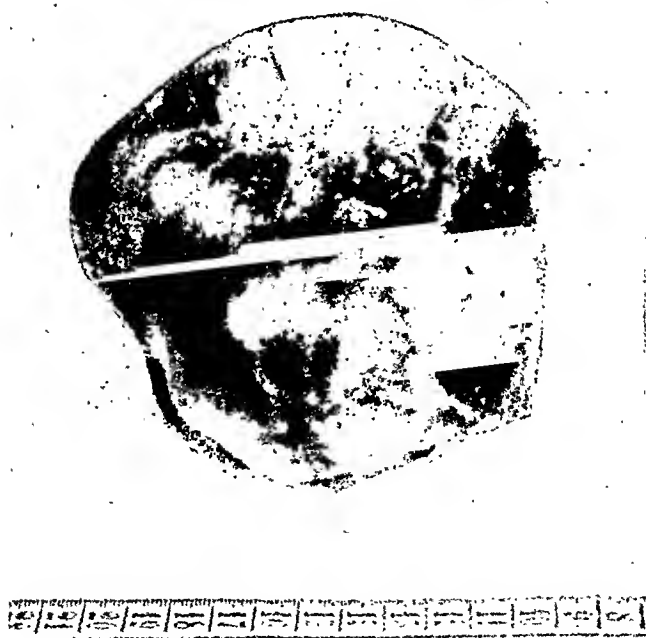


Fig. 2.

ALSÉN: Hemangioma of the Liver.



She had been ambulant for the last fortnight. Stools and urination normal.

*Status on admission.* General condition good and fairly uninfluenced. Heart: Rhythm regular, forceful sounds but no murmur. Blood pressure: 160/100. Lungs: 0.

*Abdomen:* Marked distension in the umbilical region where a round rather firm mass is palpated; it is well defined, reaching approximately 3 fingerbreadths above the umbilicus and disappearing towards the small pelvis. It is about the size of a child's head and is freely movable in the abdomen; it can easily be shifted from the one flank to the other but not upwards. There is no abdominal tenderness. — Bimanual examination: Portio is small and retracted. Uterus difficult to outline as the patient cannot relax the abdominal wall; but the growth does not seem to have any association with uterus nor to arise from the pelvic organs. N. P. N. 28 mg %. Urinalysis: 00. Sediment 0—1 red cell per field, occasional white cells, 0 casts, 0 bacteria. Weber in feces: Traces. Hb. 80 %, red cells 3,520,000, index. 1.15, white cells 6,200, polymorphonuclears 4.0, monocytes 2.2.

<sup>12</sup>/<sub>2</sub> *Operation.* Removal of hepatic tumor. Spinal anesthesia: good effect. Midline incision below the umbilicus with extension upwards to the left. — On opening peritoneum a round blue-glistening tumor twice the size of a fist is observed to the left of the abdominal cavity at the level of the costal margin. The tumor arises from the lower edge of the left hepatic lobe with a broad pedicle nearly 8 cm. in length. The growth is partially cystic. The surface is smooth. After grasping the pedicle with curved forceps the tumor is excised from the liver. Two or 3 larger arteries are ligated after which the liver margins are sutured together and the bleeding is arrested satisfactorily; it is feasible to cover nearly all of the margin with serosa. The gallbladder is normal. On the upper surface of the liver numerous small granules are palpated and grayish—white granules the size of a grain of rice are observed at the margin of the liver. After having removed a number of coagula a section of omentum is drawn over the sutured liver margin. Primary closure of the abdomen.

*Specimen.* The tumor, which weighed 725 gm. had the shape of a large uterus with a length and breadth of 13 cm. and a thickness of 7—8 cm. On incision of the midline of the growth about 300 cc. of thick dark blood was emptied from a cystic cavity engaging nearly one-half of the tumor. The remaining portion was surrounded by a capsule and had a flaccid bluish-red cut section. Cavernoma? (Fig. 1 & 2).

*P. a. d. 1.* This was undoubtedly initially a cavernous angioma, remnants of which still are present. There is now, however, to a great extent a transition to angiosarcoma with an infiltrated type of growth. (FORSELIUS.)

2. Various portions of the sections of the macroscopically hemangioma-like tumor show the picture of a very cellular malignant tumor of epithelial character. The tumor cells are rather small, rounded or flattened cylindrical with clear cytoplasm and rounded chromatinic nuclei. The cells are in some areas gathered in small spheres, in other

areas forming small lumina, in still other areas showing a trabecular arrangement. The cell pictures are on the whole fairly uniform. In several areas the tumor tissue is pervaded by wide capillaries or by partially cystic bloodfilled lumina, thus also microscopically having a hemangioma-like appearance. The cell pictures, however, are not similar to those observed in the relatively uncommon hemangioma-endotheliomas of the liver, nor do the capillary endothelials in the adjoining liver parenchyma exhibit the changes characteristic to this type of hepatic tumor. — In several areas the tumor appears to be fairly well circumscribed and is to a great extent capsulated. There is in some areas a picture of partial infiltration to the adjoining liver parenchyma. The tumor tissue here has fairly large cells and is somewhat polymorphocellular.

As far as can be judged this is an adenoma of the liver with wide capillaries and areas of hemorrhage. There are pictures of malignant degeneration with infiltration of the adjoining liver parenchyma.

P. A. D. Adenoma of the liver with malignant degeneration, wide capillaries and hemorrhages. (REUTERWALL.)

2/15: N. P. N. 30 mg. 2/18: Plasma albumin 5.4 %. 2/26: Rise in temperature, general malaise, nausea and vomiting. The patient complains of a "cold". Penicillin is instituted instead of sulfathiazole which had been administered for a few days. — The wound healed at primary intention. — The patient has post-operatively been very fatigued and has made slow progress, has had a poor appetite and has off and on vomited. Pulmonary X-ray: Broncho-pneumonia-like infiltration paramediastinally below the right hilus filling the cardiohepatic triangle. Indistinct contour of right diaphragm. No metastases visualized in the lungs. Urinalysis: Heller negative. Sediment: Occasional white cells, for the rest nothing pathological.

3/6: The patient is made ambulatory.

3/10: Marked improvement this last week, appetite good. Discharged today for further convalescence at home. The patient is given a tonic to take home. At follow-up examination in October in connection with admission to the hospital for an acute infection of influenzal type no recurrence could be established nor were any metastases demonstrated on X-rays of lungs and spinal column. The patient was again discharged well and free from symptoms.

In none of these both cases was the diagnosis established prior to operation. The first case was operated with the suspicion of a cholecystitis and there was some support for this diagnosis in the X-ray report. In the second case there was no definite diagnosis but in view of the great mobility of the tumor and the site in the upper abdomen it was considered to arise from the mesentary or possibly from the omentum. The resection of the tumors did not present any particular technical difficulties; in the first case, with the tumor arising from the right hepatic lobe one entered a layer where the growth after the ligation of a couple of larger



vessels was fairly easy to strip out with virtually no bleeding, after which the bed of the tumor was covered partly by the gall-bladder which was left intact. In the second case, in which the growth arose from the left hepatic lobe, it was so highly pedunculate that there was not much difficulty in applying clamps to the pedicle and then without essential bleeding extirpating the entire tumor and also covering most of the raw surface of the wound. The further course was in the first case virtually free from complications and in the second case rather prolonged and complicated by a bronchopneumonia.

As was mentioned above, SCHUMACKER in 1942 reported a personal case of operated hepatic hemangioma, at the same time reviewing 66 cases from the literature. Two of these were from Sweden and both published in 1902; C. A. LJUNGGREN's case arose from the right hepatic lobe and KARL DAHLGREN's case from the left hepatic lobe and both were operated with a favorable outcome. LJUNGGREN had to pack in order to arrest the bleeding, while DAHLGREN employed mass-ligatures, Paquelin's cautery, and suture of the omentum to the liver, with a subsequent primary suture. A case from Norway also was published in 1939 by MAGNUS DAHLE, Bergen, with a hemorrhage and rupture to the abdominal cavity. In this case it was not possible to remove the tumor; a xeroform gauze pack was applied to the bleeding tumor with the object of producing adhesions between the liver, the diaphragm and the adjacent organs. The patient was discharged free from symptoms 3 weeks postoperatively. — According to SCHUMACKER the youngest patient was 6 years old and the oldest 76; the average age was 44 years. Females were affected in a ratio of about 4.5 to 1 male. In 30 cases the tumor was found to arise from the left lobe, in 18 cases from the right lobe, and in the remaining cases from multiple lobes. Resection was carried out in 56 cases with only 1 death (in shock). Puncture, tamponade or some other palliative procedures were carried out in 11 cases, with 5 deaths. 2 cases were treated with considerable success with X-ray therapy. — The correct diagnosis was made only twice before operation. The majority of the cases were operated with the diagnosis of abdominal tumor with the suspicion of ovarian, omental, mesenteric, renal or colonic tumors. — According to TERRIER and AUVRAY there is reason to suspect hepatic angioma when

- 1) The tumor appears in the upper abdomen, usually to the right of the midline and develops from above—downwards.
- 2) It follows the respiratory movements.
- 3) Its percussion sounds are in direct continuation with those of the liver.
- 4) Connection with the liver is demonstrable by palpation.
- 5) The tumor is freely movable from side to side.

In regard to the operative technic the tumors arising in the left lobe and which are pedunculate seem to be the easiest to remove. — Ligature of isolated bleeding vessels, mass-ligature, Paquelin's cautery and in some cases packing have been employed to arrest the bleeding. — SCHUMACKER warns against puncture or incision of the tumor because of the great danger of hemorrhages, this being much less if dissection is done in the surrounding healthy liver tissue.

As these hepatic tumors are not distinguished by any distinct symptomatology their greatest interest is perhaps from the point of view of differential diagnostics as compared to other more commonly occurrent abdominal tumors of various types and with the rare echinococcus cysts.

### Summary.

The author describes 2 cases of cavernous hemangioma of the liver in females of 63 and 58 years of age, respectively, the tumor arising from the right hepatic lobe in the one case and from the left hepatic lobe in the other case. Both cases were operated with a favorable outcome. — In this connection is cited HARRIS B. SCHUMACKER's review of the 67 cases published up to 1942, no author, however, having had more than a single case.

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## Selective Abdominal Vagotomy.

By

CURT FRANKSSON.

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Many believe that hydrochloric acid is mainly responsible for the development of gastric and duodenal ulcer. A decrease in acid production has been sought through different means, one of the latest and most interesting being vagotomy.

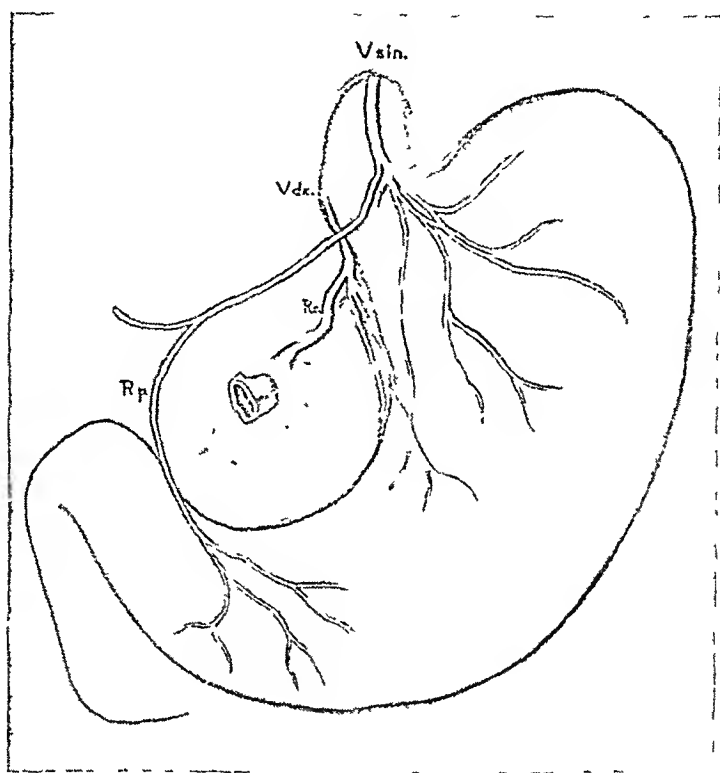
As preconised by American authors, it consists either in a section or partial resection of the vagi main trunks or any variants of these performed above or below the diaphragm. When thus performed, vagal influx to all abdominal viscera is interrupted, with sometimes undesirable consequences such as motility disturbances of the small bowels even to the point of threatening life.

In order to prevent these disadvantages of vagotomy we in the surgical department of K. S. have tried to perform a selective vagotomy.

As previously stated, reduction of the production of hydrochloric acid is the aim of vagotomy. The HCl is mainly secreted by the corpus of the stomach, while the secretion of the prepyloric region is more or less insignificant. By respecting the innervation of the prepyloric region the same HCl-reducing effect can be obtained as by such total vagotomy as recommended by American authors. The prepyloric region is considered responsible for most of the motility and consequently the evacuation of the stomach.

The right and left vagus nerves innervate the stomach and branch out from the lesser curvature into the walls. The left vagus gives off a branch 2—3 cm below the diaphragm. It travels through the lesser omentum towards the hepatic hilum. On the way it sends off a small branch which innervates the upper portion of the duodenum, the pylorus and the prepyloric region. This last branch can be respected by abdominal vagotomy (R. p.).

In five cases where total vagotomy was performed, the function of the prepyloric nerve (R. p.) was explored with electric stimuli. The sectioned nerve was isolated at its ramification point from the main branch (arrow in the fig.). It was stimulated by faradic current inducing a contraction of the prepyloric region.



Semi-schematic drawing<sup>1</sup> showing the right vagus with coeliac ramus (R. c.) and left vagus with prepyloric ramus (R. p.). The arrows point to the branches which can be sectioned and points of section.

A duodenal sound had previously been inserted and during stimulation gastric secretions were obtained. The quantities obtained were small (2—4 ml) and the acidity low ( $\text{HCl} < 5$ ).

The other abdominal viscera get their vagal innervation from the coeliac plexus, which is supplied by an important branch (R. c.) from the right vagus main stem originating 3—4 cm below the diaphragm. It travels behind the very thin lesser omentum and along the posterior wall of the abdominal cavity downwards to the right. After a course of 2—4 cm it reaches the coeliac plexus on the ventral side of the aorta, close to the coeliac

<sup>1</sup> The drawing has been executed by Dr. BJÖRN LINDAHL, Stockholm.

artery. A thin ramus shoots off from the left vagus over the upper part of the stomach and along the left gastric artery to the coeliac plexus. — The main vagal contribution to the coeliac plexus originates from the right vagus. The coeliac branch of the right vagus can also be spared by abdominal vagotomy.

A selective abdominal vagotomy is performed as follows. — The left liver-lobe is loosened from the diaphragm. Right and left vagus are dissected from the oesophagus. A catgut is put around each of them and by these the vagi are lifted. Their branches are thus stretched and made visible through the fatty tissue. — It is preferable to attend to the left vagus first. The branches to the stomach are sectioned (at the arrow in the fig.) thus respecting the ramus through the lesser omentum to the hepatic hilum and the prepyloric region (R. p.). This ramus should be dissected right into the lesser omentum. Then it can be held towards the diaphragm, clearing out the field for further steps. — The right vagus is stretched and thus made visible through the lesser omentum which is there very thin, making a blunt dissection possible. The right vagus is seen to ramify as a bundle of nerves, which runs to the posterior wall of the stomach and a rather thick ramus (R. c.), which after running 2—4 cm. downwards and to the right is buried in the coeliac plexus. The branches to the stomach are sectioned at the arrow of the figure.

A vagotomy performed as above results in denervation of the upper part of the stomach (fornix, corpus, sinus) while the prepyloric region remains autonomous and thus retains its motility which is so important for the evacuation of the stomach. The other abdominal viscera pancreas, small bowels and so on, have also retained their vagal influx.

The method has been in use at Karolinska Sjukhuset for some time and six cases have been treated. Data have been compiled in the following table.

Case no.	Highest HCl-level of insulin-test		Localisation of the ulcer	Degree of healing 10 days post op.
	before op.	after op.		
1 .....	46	5	ventr.	decreased
2 .....	25	0	ventr. + duod.	healed
3 .....	30	0	ventr.	»
4 .....	66	50	duod.	»
5 .....	70	30	duod.	»
6 .....	68	0	duod.	»

10 days after operation there is a decrease in the hydrochloric acid production at the insulin test, in some cases achylia. The ulcers have decreased or healed.

### Summary.

Reduction of the hydrochloric acid production is the purpose of vagotomy. Instead of sectioning the main trunks of the vagi, only the vagal branches of the HCl-producing parts of the stomach, are sectioned. Thus getting reduced hydrochloric acid production while vagal influx to the prepyloric region and the other abdominal viscera, is respected.

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## Operative Technique and Subsequent Care of Transvesical Prostatectomy.<sup>1</sup>

By

AULIS KORHONEN.

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Prostate surgery was one of the subjects discussed at the congress of the Society of the Scandinavian Surgeons in Stockholm 1947. The outlines of the problems to be discussed were presented by GUSTAV GIERTZ from Stockholm, STEIN F. HOLST from Oslo and H. ABRAHAMSEN from Copenhagen. These meritorious introductions reveal that the operative technique and the after care in the various hospitals of these Scandinavian countries differ a great deal. Such is the case most likely even in the Finnish hospitals and that is why I think it advisable to describe the procedures I have adopted as a result of my experiments during the last few years.

That *preparatory measure* which has been in general use in Finland up to the present moment is the *resection of ductus deferens*. I myself never more resort to it unless the *urinary ducts present a specially malignant infection*, as the antibiotics of today enable one to master the infection in the urinary ducts to such an extent that the risk of epididymitis is practically negligible.

I always carry out the operation under lumbar anaesthesia injecting also procain into the abdominal coverings.

After filling the bladder with physiological saline solution an incision is made in the usual manner lengthwise above the symphysis. The peritoneal fold is taken bluntly far enough towards the fundus with the finger and with a plug of gauze and the *incision is made in the fundus part* of the bladder as far as possible

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<sup>1</sup> A lecture given in the annual meeting of the Society of the Finnish Surgeons on the 31. Oct., 1947.

in fundus, not in the cervix. Usually the prostate can be reached with the finger through the wound effectuated even in this way quite well because the front wall of the bladder gives way under the hand sinking inwards if the peritoneal fold is pushed backwards far enough. It is only in *obese patients* that the reaching of the prostate may be *hampered*, but in such cases *the incision may always be lengthened towards the cervix*. The saline solution which oozes out of the wound is sucked with the suction-apparatus. An incision is made with the knife in the prostatic tissue in the superior and inferior edge of the inner orifice of the urethra and the opening is made wider by inserting the finger through it. When the assistant has inserted his finger into the rectum and raised the prostate upwards *the prostate is detached beginning medially from below and counting upwards towards the sides* each lobe being raised separately. *Attention is then given to haemostasis*. I have altogether given up the Pilcher-ball and protracted tamponade. It appears to me that their use is based on utterly erroneous principles since they prevent the prostate bed from contracting as quick as possible, which fact alone will contribute to the collapse and thrombosis of the bleeding vessels. I have also given up suturing the prostate bed because it may often be technically rather awkward, especially when the incision is made in the fundus part of the bladder. I have attended to haemostasis so that *a plug of gauze, attached to the point of the slightly curved forceps and dampened in adrenaline solution is applied to the prostate bed* and is kept there for a few minutes. The adrenaline then has contracting influence on the blood vessels. Subsequently *a similar plug, dampened in peroxide*, is inserted into the prostate bed against the walls of which it is pressed for ten minutes. Peroxide is an excellent haemostatic agent and does not at all irritate the bladder mucosa when used only for such a short while. *By the above procedure haemostasis is usually arrested so that only slight oozing appears instead*. The end of the catheter which is inserted into the bladder through the urethra is then withdrawn from the cystostomy opening and the other end of the indwelling rubber tubing is fastened to it with one single suture and is subsequently drawn out through the urethra by means of the catheter. The one-piece rubber tubing where there are two holes close to each other in that portion which remains in the bladder, is now running through the bladder and passes both through the urethra and the cystostomy opening and the abdo-



minal coverings.<sup>1</sup> *This kind of indwelling tubing has the advantage that the whole system is easily mastered by it. By the possible obstruction of the holes or of the tubing by coagulated blood these parts of the tubing where the holes are situated are easily withdrawn and the cavity of the tubing is irrigated without difficulty. When the wound is sutured in two layers, I place the tubing so that it runs from the fundus corner of the wound. The peritoneal fold is then enfolded with a couple of sutures around the tubing over the edges of the vesical wound. This procedure has an advantage, viz., after the removal of the indwelling tubing and after placing the indwelling catheter through the urethra the peritoneal fold soon falls over the orifice of the wound forming over it a sort of stopper, the oozing of the urine through the opening stops sooner and the opening will close quicker. The insertion of the tubing into this place is also advantageous in another respect. When the opening is situated in the highest portion of the bladder while the patient is in a lying position the inner pressure of the bladder is least just there, which naturally will contribute towards the quick closing of the opening and of the wound of the abdominal coverings. Such is not the case if the incision is made into the neck from where urine may easily ooze out into the cavum Retzii. More particularly if the urine is infected a protracted suppuration may ensue in the last mentioned case. I usually place a small separate rubber tubing into the cavum Retzii for one or two days as a safety-valve.*

Irrigation is carried out immediately after operation using physiological saline solution by means of the rubber tubing and I ensure also that the lateral holes of the tubing are in their right places in the vesical cavity and that the passage in the tubing is free. Subsequently, in the ward, *a dripinfusion apparatus is attached to that end of the tubing, which runs through the abdominal coverings. This apparatus, which contains physiological saline solution, effectuates the continuous douche of the bladder so that the douche-solution is let to flow with the speed which is customary in drip infusion. Observation is carried out by means of a glass ball which is attached to the tubing of the irrigator. This procedure has the advantage of preventing coagulated blood from collecting either in the bladder or in the indwelling tubing, and it allows the patient to rest undisturbed after operation while the system works itself. The patient need not be constantly disturbed as is the case*

<sup>1</sup> The indwelling tubing is first mentioned by MÜLLER and as used by SEIRO.

by syringal irrigation where the tubing is apt to get stopped. Furthermore the continuous irrigation is an aseptic procedure, which cannot be said of the syringal irrigation. The nurse has merely to fill the irrigator when necessary and empty the urine bottle to which the other end of the tubing leads.

*As soon as the douche-solution does not present any coagulated blood* the indwelling tubing is removed and the indwelling catheter is inserted transurethrally which again will be removed after the closing of the cystostomy opening.

Since the beginning of the year 1946 55 transvesical prostatectomies have been carried out at the General Hospital of Pori up to the present moment and 52 of them have been operated by myself so that the material is homogeneous in this respect.

There were 28 cases that presented an infection in the urinary tracts pre-operatively. There were staphylococci in 7 cases, *b. coli* in 4, and in 17 cases both staphylococci and *b. coli* were found.

In 3 of the cases infection has occurred postoperatively in the urinary ducts, previously aseptic, during the treatment. The infection of all the patients was pre-operatively treated with sulpha preparations and with mandelic acid, sometimes with penicillin. The aseptic cases were treated after operation with prophylactic sulpha until the removal of the indwelling catheter. Of the infected cases the infection disappeared during the treatment in the hospital in 15 cases, later in 8 cases. There is not exact report on 5 of the cases but even those patients have declared to be without symptoms.

Resection of ductus deferens has been performed in 5 cases only. These cases presented a particularly malignant infection and it was necessary to leave the indwelling catheter for a considerable period of time owing to the complete state of retention during the preparatory treatment before operation.

There have been 2 patients who have presented a postoperative epididymitis during their stay in the hospital, in two it appeared about a month after the operation after the discharge from the hospital because they had given up the treatment of the infection in the urinary ducts. The infection was rather mild even in these cases and the swelling disappeared in 7—10 days.

In the following table I have presented the 20 cases operated on in 1946 and the 35 cases operated on in 1947. Regarding how long the indwelling tubing was kept in and how long it took till the cystostomy opening was closed for the operative technique

	Duration of the indwell- ing tub- ing	Number of cases	Closing of the cystost. opening	Number of cases
The 20 cases of the year 1946	2 days	2	4 days	1
	3 "	8	8—10 "	8
	4 "	6	11—14 "	5
	5 "	2	15—19 "	5
	6 "	2	24 "	1
The 35 cases of the year 1947	2 "	21	4 "	1
	3 "	8	6 "	18
	4 "	6	8—10 "	10
			11—14 "	6

used in the years mentioned above, has differed to a certain extent.

In the cases operated on in 1947 the indwelling tubing was instantly removed when no coagulation of blood was to be found in the douche-solution and when no risk of the stopping of the catheter was present any more. The cystostomy opening was made in the fundus of the bladder, with the patient in a lying position, in the highest point of the bladder and the peritoneal fold was enfolded by suture around the indwelling tubing where it comes out from the bladder. In these cases I have deliberately strived to effectuate the quickest closing possible of the cystostomy opening after the removal of the indwelling tubing.

As it appears from the above table in 2 of the 20 cases operated on in 1946 the tubing has been removed after 2 days, in 8 cases after 3 days, in 6 cases after 4 days and in the remaining 4 cases after 5—6 days. The cystostomy opening became closed on the 10 postoperative day at the latest in 9 cases and on the 11—19 day in 10 cases. In one case only the opening was closed as late as on the 24 postoperative day. This case presented a persisting suprapubic fistula, made previously elsewhere, the tissues were cicatrized and in the bladder there was a serious infection, which factors retarded the healing.

In the 35 cases of the year 1947 the indwelling tubing has been removed after 2 days in 21 cases, after 3—4 days in 14 cases. The cystostomy opening was closed after 6 days at the latest in 19 cases, after 8—10 days in 10 cases and after 11—14 days in 6 of the cases. In my opinion this result is to be considered good as compared with the cases of the year 1946 where only in 1

case the opening was closed on the 7 day and most of the cases, in 8, on the 8—10 day.

Not once have there occurred troublesome bleedings afterwards which would have given rise to further steps, nor have there been any kind of complications except for the 4 cases of epididymitis mentioned above.

Of all the patients 46 have been postexamined by myself 1—2 months after the discharge from the hospital. As for the remaining cases information about their condition was received by letter. All of them are without symptoms and urination is normal.

None of my cases died.

### Summary.

The most advantageous procedure by transvesical prostatectomy is to make the cystostomy opening, with a view of effectuating the quickest possible closing of the wound, in the fundus of the bladder in that point which is highest when the patient is supine.

After prostatectomy a particularly advisable procedure to arrest bleeding is the tamponade of about ten minutes of the prostate bed during the operation with a plug of gauze dampened in adrenaline solution first, then in peroxide. The bleeding is thus normally arrested while only slight oozing takes place instead. Not once have there been troublesome bleedings or other such complications as should necessitate additional measures in my 55 cases.

With a view to the after-care it is best to use a one-piece indwelling rubber tubing which runs through the bladder and the abdominal coverings and around which, there where it comes out of the bladder, the peritoneal fold, bluntly detached from the bladder, is enfolded by suture. After the removal of the tubing it falls over the opening forming thus a sort of stopping promoting the closing of the opening.

The indwelling tubing is attached to the continuous drip-apparatus which prevents the tubing from getting stopped. By this procedure the after-care is aseptic, it is not troublesome and is not too great an exertion for the patient.

The indwelling tubing is removed when the douche-solution does not present coagulations of blood any more, usually on the

2—3 postoperative day. An indwelling catheter is then placed transurethrally into its place which again is removed immediately after the closing of the cystostomy opening, which closing in 19 out of my 35 cases took place as early as on the sixth postoperative day.

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From the Surgical Department A of the University Clinic  
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Chief: JOHAN HOLST, M. D.

## **Pneumectomy for Pulmonary Metastasis from Cancer of the Uterus 10 Years after Hysterectomy.**

By

KAARE LIAVAAG.

Total pneumectomy, or pulmonary resection, for metastatic neoplasms has up to the present date not been a common operation. An assumed solitary pulmonary metastatic malignant neoplasm occurring months or years after radical operation for sarcoma or carcinoma is no rarity, however. If not treated surgically, these patients invariably die, either from secondary pulmonary involvement, or secondary metastases and marasmus. The operative treatment of these patients is of course very uncertain, but the patients have no other chance. Thus, operative treatment may in some instances be justifiable.

The appearance of a solitary, round tumor with sharply defined edges months or years after the removal of a malignant lesion from some other part of the body suggests metastasis. Nevertheless, the pulmonary tumor may be a primary one. The symptomatology may give no hold for a differential diagnosis. Both forms may be symptomless for a considerable period of time, and when symptoms appear, they may be identical. Even the presence of a bronchoscopically visible neoplasm does not exclude the lesion being a metastatic one, although a biopsy in such cases will yield information of the nature of the tumor.

Before such a radical procedure as pneumectomy is decided upon, a thorough physical and x-ray examination must be carried out in order to exclude the presence of other metastases. Furthermore, assurance should be had that there is no recurrence of the

primary neoplasm. The patient must be in a sufficiently good general condition and have sufficiently large vital capacity, so that it is probable that he will survive pneumectomy. It may be a question whether the operation is justified at all. However, the material available is still too small to be conclusive. It must also be remembered that a patient who has had another malignant neoplasm very well may develop a primary cancer of the lung.

ALEXANDER and HAIGHT, in 1947, have collected 24 cases of solitary pulmonary metastatic neoplasm which have been treated by lobectomy or pneumectomy. These cases represent metastases from tumors of different organs. There were 16 carcinomas and 8 sarcomas. Six hypernephromas (renal cell carcinoma) were included in the group of carcinomas. The rest of the carcinomas were located to the rectum, bladder, uterus, ovary and testis. The carcinomas were partly soft tissue sarcomas, partly sarcomas of the bone. One of the patients died as a result of the operation. Recurrence appeared in 11 of the patients within a short period of time. The remaining 12 survived, 4 of these, however, had an observation period of less than a year. In the remaining 8 patients there was no recurrence after 12, 7, 5, 4, 3 and  $1\frac{1}{4}$  years, respectively. The one who was alive 12 years after the operation was a patient with metastasis from a hypernephroma, the metastasis being detected before the primary tumor. Only 6 of the 15 carcinoma patients, but 6 of the 8 sarcoma patients were alive. The time elapsing between the occurrence of the primary tumor and that of the metastasis varied from some months to 13 years. ALEXANDER states, based upon theoretical considerations, that the prognosis should be most favourable with an interval of several years between the two junctures, the chances thus being that the metastatic neoplasm really is a solitary one, and that the growth has taken place slowly, indicating a more benign nature of the metastatic lesion. But a closer study of the casuistics does not support these theoretical considerations.

From the figures mentioned above it appears that surgical removal of a metastatic malignant neoplasm that is assumed to be a solitary one, is justified under special circumstances. We have recently had a case of this type.

*Case. K. L. Reg. no. 3529/47*, a 68-year-old woman, was operated upon in 1937 for cancer of the uterus (hysterectomy). In 1939 radium therapy was given, after which she was free of subjective symptoms. In the autumn 1945, an X-ray survey, a round infiltration of the

right lung was accidentally detected. (Fig. 1.) It was interpreted as a specific lesion, and she was treated conservatively. She had no pain, no fever, although a sparse tenacious, mucous sputum was occasionally seen. Periodical X-ray examinations showed that the infiltration was increasing in size. During the last year she suffered slight dyspnea on exertion. She was admitted to the Surgical Department A on September 26th, 1947.

On admission the following data were revealed: Normal appearance, temperature 37.1°, pulse 72, blood pressure 165/100. The respiration was normal. Gynecological examination revealed that the internal genitalia had been removed. There were no signs of local recurrence. Otherwise the physical examination revealed normal conditions. The hemoglobin level was 103 per cent, and the sedimentation rate was 8 millimeters. An EKG showed left axis deviation, but was otherwise normal. Tubercle bacilli could not be cultivated from the sputum. *Bronchoscopy* revealed bronchitic changes, but no signs of tumor formation could be seen in the central bronchi. The vital capacity was 2,000 cubic centimeters. *X-ray examination* disclosed an almost circular shadow, 5 by 5 cm., laterally to the right hilus. The shadow was dense and sharply circumscribed. (Fig. 2.) Planigraphy did not reveal any special relation of the tumor to the bronchi or vessels. The roentgendagnosis was: Malign tumor, probably metastasis. We were not quite certain of what to do with the patient. As no local recurrence of her uterine cancer could be detected, and no other metastasis were found, we decided to operate. Whether the tumor was a metastatic one, or a primary carcinoma of the lung, the patient would have no other chance except for that of a successful surgical removal of the lesion.

The operation was performed on October 9th, 1947, with the patient under endotracheal anesthesia.

*Pneumectomy Dextra* (K. LIAVAAG). A postolateral incision was made, and the sixth rib was resected. The pleural cavity was free, no adhesions. An egg-sized hard tumor was felt in the middle lobe, partly extending to the upper lobe. There were no enlarged hilar or mediastinal lymph nodes. Under these circumstances pneumectomy seemed to be justified, and the operation was performed in the usual way with individual ligation of the hilar structures. The mediastinal pleura was sutured over the bronchial stump, followed by air-tight closure of the wound without drainage. The postoperative course was uneventful. The reactive pleural exudate was aspirated twice. The patient was discharged on November 12th, 1946, feeling well except for a slight dyspnea on exertion.

*Microscopical examination* of the removed tumor showed an atypical epithelium of the infiltrating variety with a regular, glandular arrangement of the cells, although the growth in some areas had a somewhat papillomatous character. The cells were partly high, cylindrical ones, partly more cubical or polyhedral cells. The size and the contents of chromatin of the nuclei varied. Some mitotic figures were seen. The picture might very well be that of a metastasis from an adeno-



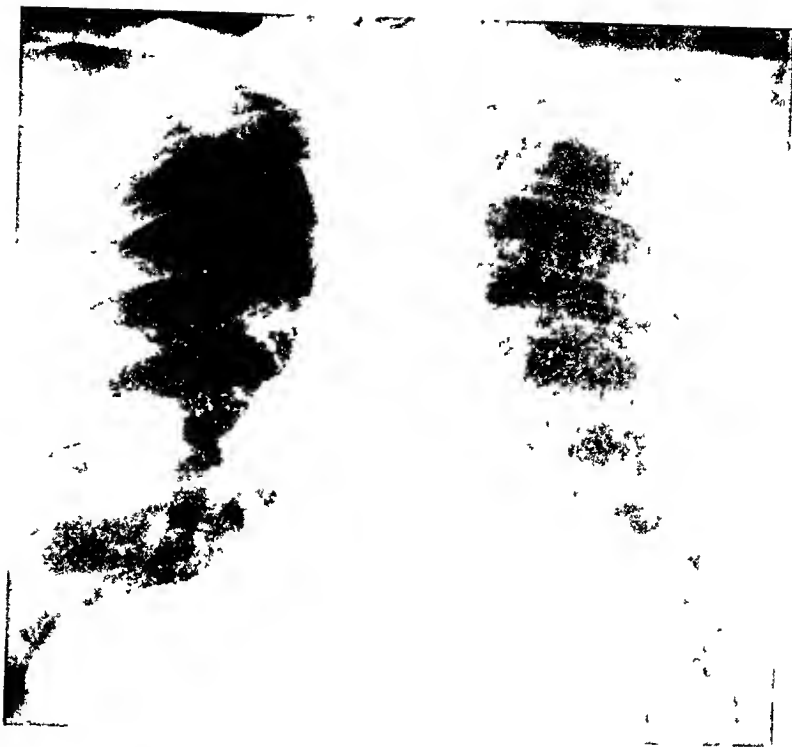


Fig. 1. X Ray one year before admission.

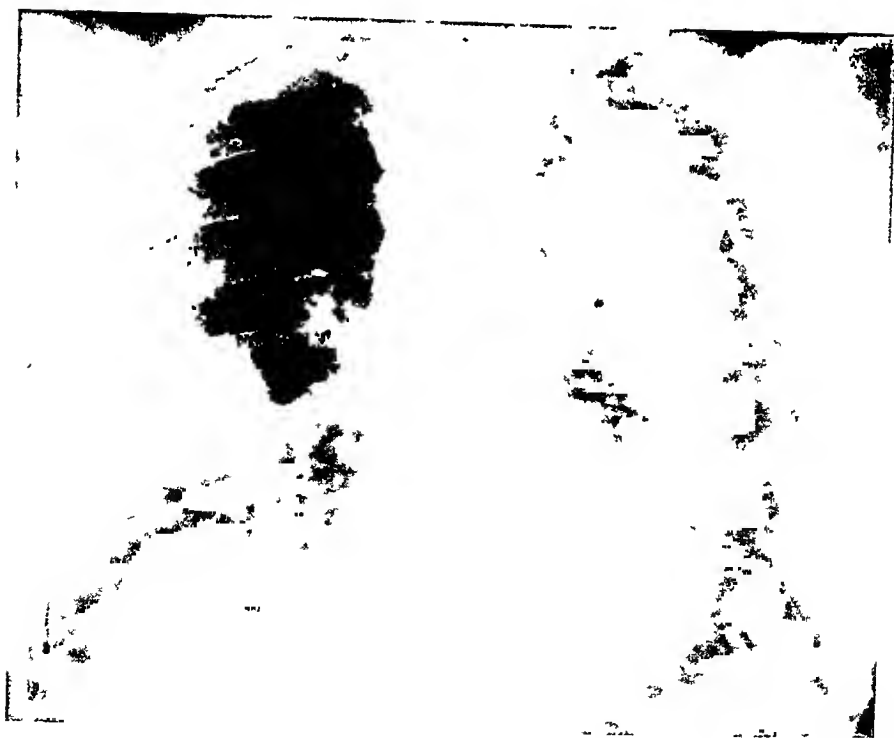


Fig. 2. X Ray just before operation.

LIAVAAG: Pneumectomy for Pulmonary Metastasis.

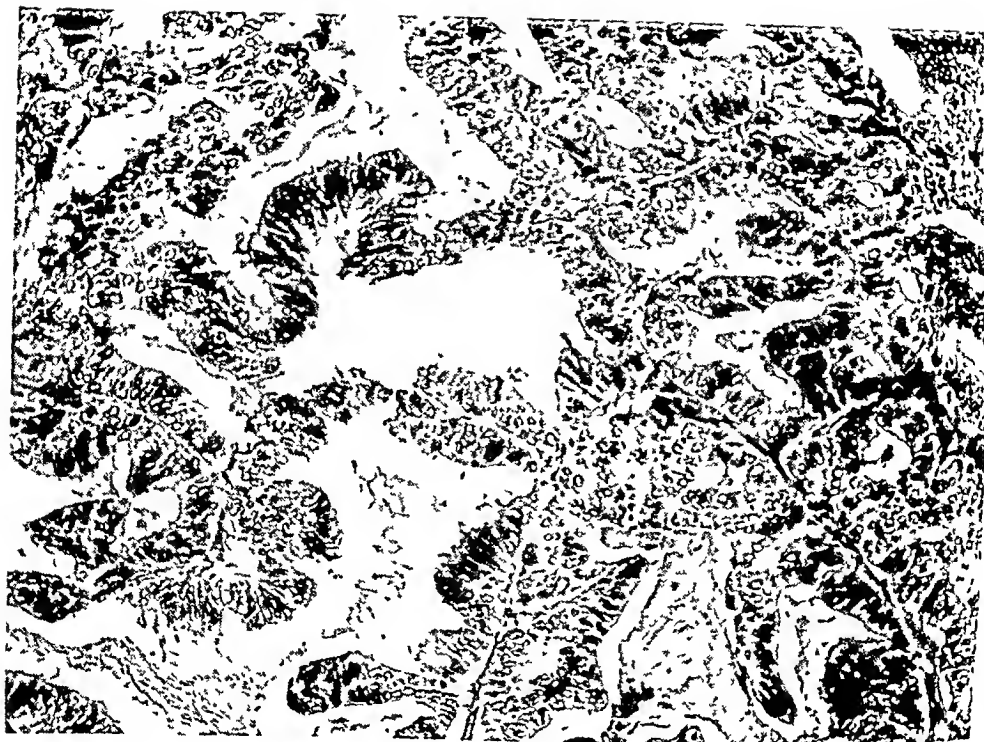


Fig. 3. Photomicrograph of the pulmonary tumor.

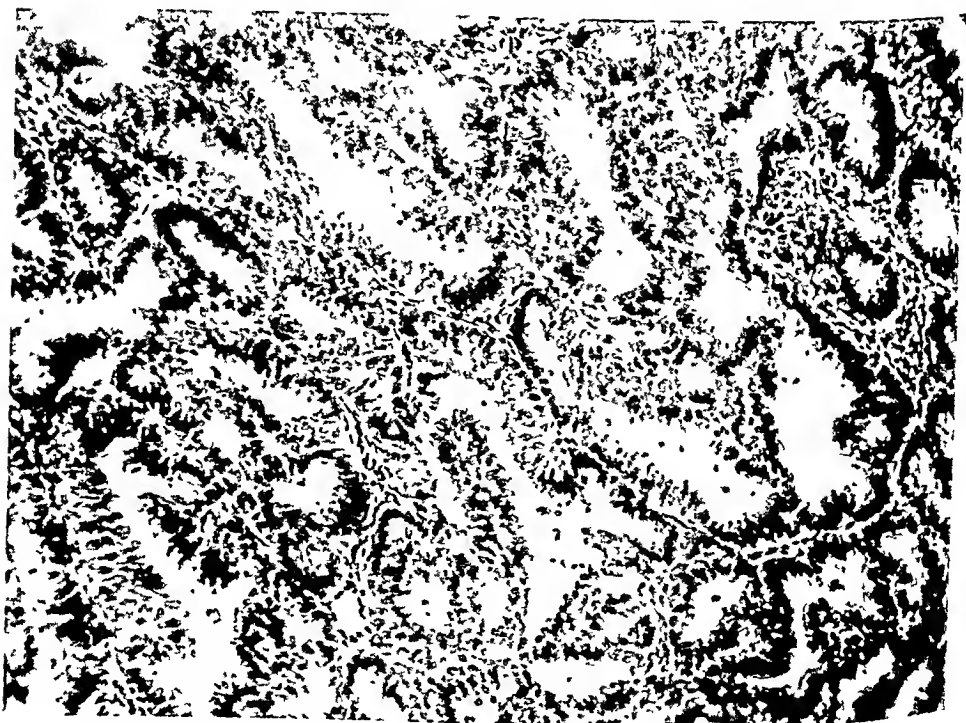


Fig. 4. Photomicrograph of the primary tumor in the uterus.

carcinoma of the uterus. However, primary bronchial carcinoma could not be excluded. (Fig. 3.) *D: Adenocarcinoma* (J. EFSKIND).

The microscopical specimen of her uterine cancer has been procured from the Radium Hospital. It shows the same epithelium of the infiltrating variety. The same glandular arrangement is seen, and also the same tendency towards papillomatous growth. (Fig. 4.) Comparing the two specimens, it is justified to conclude that the pulmonary neoplasm is a metastatic one from her uterine cancer.

There are several features of this case which merit attention. First, there is the long interval between the occurrence of the primary tumor and that of the metastasis. As no sign of local recurrence had appeared, one may assume that the metastasis, at least microscopically, has been present all the time, but that the growth has taken place very slowly. It has been observed that the growth of metastases has been arrested, or even regressed, after the removal of the primary tumor. In the case of BREZINA and LINDSKOG 13 years elapsed between the occurrence of the primary tumor and that of the metastases. That is the only case of pulmonary metastases from uterine cancer previously reported in the literature which has been treated by pneumectomy. Secondly, there is the accidental detection of the metastases on a mass examination, at a juncture when it still was asymptomatic and silent. Although this cannot be regarded as unusual. Pulmonary metastases may not cause symptoms until the pre-mortal stage has been reached. However, the circumstance may have a practical importance, as these solitary pulmonary metastases now may be successfully removed by lobectomy or pneumectomy. Not only a local examination, but also an X-ray examination of the lungs should be included in the routine check-up examination of all surgically treated cancer patients, therefore. Thus, an assumed solitary pulmonary metastatic neoplasm may be detected early enough for a successful surgical removal, as in the case here reported.

### Summary.

The author reports a case of solitary pulmonary metastases in a 68-years-old woman who 10 years previously had been treated for uterine cancer by hysterectomy. Pneumectomy was performed, a good primary result being obtained.

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## Gastro-Bronchial Fistula.

### Report of a Case.

By

KAARE LIAVAAG.

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During the last war, penetrating and perforating thoracico-abdominal injuries were a relatively frequent occurrence. It is stated that they amount to about 1 per cent of the total number of war injuries (BERRY).

They were often, especially when situated on the left side, complicated by gastro-intestinal perforations. They must be characterized as very serious lesions, and most investigators estimate the mortality rate to be between 25 and 30 per cent. The mortality rate is largest in injuries of the left side. In the treatment of these injuries it has successively been made clear that the thoracic approach is the method of choice, and finally it became a rule that the treatment of these injuries should start with a thoracotomy. As the clinical diagnosis in these cases often is difficult, thoracotomy is performed if a combined lesion is suspected. BETTS thus states that 28 per cent of the thoracotomies were exploratory without any lesion of the diaphragm being found.

The experiences gained in the treatment of these injuries have also been valuable for the peacetime surgery. Wide new fields have been opened, cf., the thoracal and the combined approach in the treatment of diseases of the esophagus and upper part of the stomach.

Regarding the postoperative complications, it is stated that about 50 per cent of the deaths occurred within the first twenty-four hours as a result of shock. Otherwise, lung complications

were responsible for a larger number of deaths than complications from the abdominal organs (BETTS). It has been stressed, therefore that it should be seen to that the lung expanded during the subsequent postoperative period, and that the upper respiratory passages were aspirated.

Most of the postoperative complications were due to infection. After surgical repair of thoraco-abdominal injuries with perforation of the stomach and defect of the diaphragm, not infrequently a re-rupture of the stomach and the diaphragm occurred, resulting in empyema. SHAW has reported two such cases, SCHÄFER one.

SOMMER and MILLS have reported a case of gastro-thoracic fistula in a patient with a traumatic diaphragmatic hernia. The condition was misinterpreted as a valvular pneumothorax, and puncture was performed. Empyema developed with a fistula between the empyema and the stomach. LINDSKOG and LAWRENCE have published two cases of gastro-thoracic fistula caused by the application of a drain to the herniated stomach, the condition being misinterpreted as empyema. As it appears, these cases can be traced back to the primary injury, or to faulty treatment as a result of an erroneous diagnosis.

In our clinic, we have had a case which cannot be referred to any of these groups, and which furthermore presented the peculiar feature that the fistula did not communicate with the pleural cavity only, but extended to the lung and bronchial tree, so that a gastro-bronchial fistula was present.

*Case: Ivar D., Reg.no. 10978/47, aged 36.*

During a bombing attack on May 16th, 1940, he was hit by a bomb fragment in the left lumbar and thoracic region. The left kidney was crushed and the peritoneal cavity and the pleural sac were torn open. The five lower costae were splintered. At the field hospital a nephrectomy was performed, and multiple loose costal fragments were removed. No lesion of the gastro-intestinal tract was found. The wound became infected. He was discharged after being hospitalized for 3 months. One week later he was admitted to another hospital because of continuous vomiting. Examination revealed a traumatic diaphragmatic hernia on the left side. He was operated on September 16th, 1940, and the slit in the diaphragm was closed. It is noticed in the operational report that another slit was seen posteriorly in the diaphragm, but was left intact. So was also a bomb fragment demonstrated in the roentgenogram, and supposed to be situated in the pericardium.

There was a considerable postoperative reaction, and the wound became infected. The patient was discharged after being hospitalized for 3 months. After one year's convalescence he took up work again.





Fig. 1. X Ray of the stomach, showing the fistula to the lung.

LIAVAAG: Gastro-Bronchial Fistula.

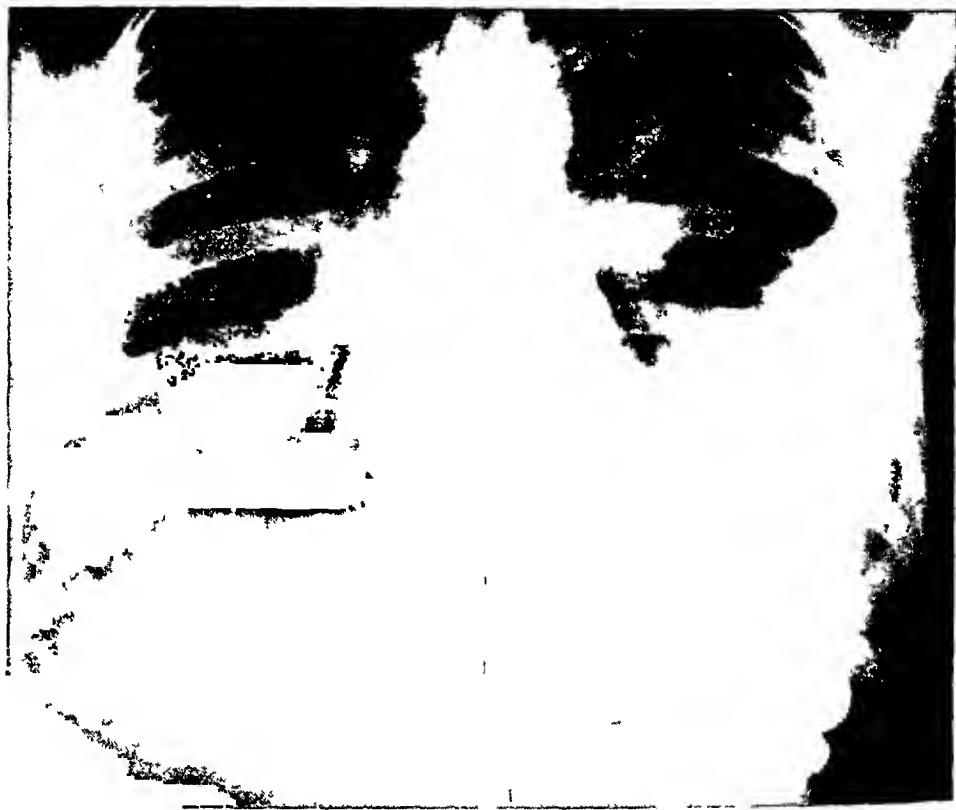


Fig. 2. Ba-enema showing the colon in the thorax cavity

He felt relatively well until 1943 when he began to be troubled by cough. The cough occurred especially after the meals, and sometimes swallowed food was coughed up. He had a tenacious, mucous sputum which occasionally was hemorrhagic. Prior to the admission he had three rather large hemoptyses, each of about 100 cc. For periods he was also troubled by pain in the upper part of the epigastrium. The patient was admitted to our clinic on April 10th, 1947.

Except for the scars from the previous operations, the physical examination was negative. The sedimentation rate was 15 mm. The white cells numbered 14,000, and the hemoglobin was 113 per cent. Roentgen examination revealed a dense foreign body in the lower part of the left pulmonary view. A diaphragmatic hernia was also revealed, with the colon and stomach in the thoracic cavity. The stomach showed two protrusions resembling diverticulas; one of these communicated with an intrapleural cavity and further with the bronchial tree, indicated by the presence of contrast in the bronchial tree when the patient was photographed after the upper part of the body had been lowered. He also coughed up some contrast after the examination. (Fig. 1 and 2.) Bronchoscopy revealed marked bronchitic changes in the bronchus of the left lower lobe. During the hospitalization the patient had a hemoptysis of about 300 cc. on May 3rd, 1947. At the same time there also was considerable hemorrhage into the stomach, and the hemoglobin level sank to 60 per cent.

The patient got a rise in temperature and was much exhausted. Five blood transfusions were given, and penicillin was administered. Thus the patient recovered. It was believed that the hemorrhage was due to the foreign body, and for this reason, and on account of the wide communication between the stomach and the bronchial tree, representing a danger of retrograde aspiration, operative treatment was considered as absolutely indicated.

The operation was performed on May 20th, 1947, with the patient under endotracheal ether anesthesia.

*Lobectomy lobii inf. sin., seclusio fistulae gastro-bronchialis, operatio radicalis herniae diaphragmaticae.* (Prof. HOLST). The usual posterolateral transthoracic incision was used. A large diaphragmatic hernia was found, parts of the colon and stomach being dislocated in the thoracic cavity. Medially to this, a 3—4 cm. long slit was seen in the diaphragm, and through this the stomach protruded into the thoracic cavity. Here a wide communication had been established between the stomach and the bronchial tree.

The stomach was freed and the stomachal defect closed. The bridge between the two hernial openings was divided. The diaphragm was sutured with Mayo sutures, and the lateral part of the diaphragm was affixed to the thoracic wall. The foreign body was situated subpleurally in the lung. The entire lower lobe was partly fibrotic, partly atelectatic. For this reason, and on account of the wide communication to the bronchial tree, lobectomy was indicated. The lower lobe was removed in the usual way with dissection lobectomy.

*Microscopical examination* of the removed lobe revealed atelectatic lung tissue with fibrosis and chronic inflammation, and bronchiectasies. The fistula was lined partly by a necrotic layer, partly by stratified squamous epithelium.

The patient showed little reaction to the operation until the 15th postoperative day, when a severe melena occurred, and the hemoglobin level sank to 40 per cent. Several blood transfusions had to be given. The condition improved, and the hemoglobin level rose to 90 per cent. The wound in the thoracic wall was drained, the secretion all the time being moderate. After 6 weeks the drain was removed, and the wound healed. Roentgen examination prior to the discharge revealed a small rest exsudate on the left side. Roentgen examination with contrast showed that the stomach was now situated below the diaphragm.

### Comment.

The case presents several interesting features. First the formation of the gastro-bronchial fistula. It is justified to assume that the fistula is related to the injury. HUDSON, in 1945, has collected 25 cases from the world literature of stomach ulcers which had penetrated and perforated into the thoracic cavity. However, no signs of ulcer of the stomach were found at the operation, so this possibility can be excluded.

It might be imagined that a primary injury of the stomach has been present, but not detected, and that this has given rise to a subphrenic abscess which then secondarily has penetrated the diaphragm and made its way to the bronchial tree. When the patient was operated for his diaphragmatic hernia the first time, no signs of communication between the stomach and the bronchial tree were found. It is unlikely that such a fistula, if existing, should not have been found at the operation. That a primary lung abscess has penetrated to the stomach is most unlikely. The most reasonable explanation is that the diaphragmatic hernia has recurred and that the stomach has become incarcerated in the hernia and then perforated. Thus, a secondary abscess has developed, and then perforated to the bronchial tree. That this complication has not given more alarming symptoms, is probably due to that the previous injury and the previous operations with associated infections have caused formation of adhesions, so that the whole process had become encapsulated when the perforation took place.

As previously mentioned, the main symptom was hemorrhage. In spite of the large intrapulmonary cavity, the expectoration was scarce. This might be explained by the fact that the relatively

wide communication between the stomach and the bronchial tree has served as internal drainage of the pulmonary focus. Prior to the operation it was assumed that the pulmonary hemorrhage was caused by the bomb fragment. However, this was found to be situated subpleurally and had no relation to the fistula. It is justified to believe, therefore, that the hemorrhages were due to erosion, or ulceration caused by the peptic action of the gastric juice, *i. e.*, that a peptic ulcer has developed in the lung tissue. Microscopical examination showed that the fistula was lined by a stratified squamous epithelium. This metaplasia of the epithelium has probably taken place just in order to protect the underlying tissue against the peptic action of the gastric juice. However, large parts of the fistula were lined by a necrotic layer. The hemorrhages have probably been caused by this necrotic layer being shed off, so that the underlying vessels have become eroded.

The postoperative melena most likely can be referred to bleeding from the suture-line in the stomach.

### Summary.

The author reports a case of gastro-bronchial fistula in a 36-year-old male who six years previously had a severe thoraco-abdominal injury on the left side. Nephrectomy had to be performed on this side. Some months later he was reoperated on account of a large diaphragmatic hernia on the left side, and symptoms disappeared for three years. Then symptoms reappeared, cough, hemoptysis, and epigastric pain.

Röntgen examination revealed a diaphragmatic hernia on the left side, and by using contrast, a fistula between the stomach and the bronchus of the left lower lobe was detected. The patient was operated, the gastric fistula being closed, the diaphragm reconstructed, and the left lower lobe removed. There came a postoperative hemorrhage of the stomach on the 15th postoperative day, but the postoperative course was otherwise uneventful. A bomb fragment seen on the roentgenogram had no relation to the fistula.

It is assumed that the fistula has been caused by incarceration of the stomach in the diaphragmatic hernia. It is furthermore assumed that the hemorrhages were due to the peptic action of the hydrochloric acid on the bronchopulmonary tissue.

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From the Surgical Clinic, Lund.  
(Chief: Professor J. P. STRÖMBECK.)

## Vitamin K for the Balancing of Prothrombin Index in Dicoumarin Treatment.

By

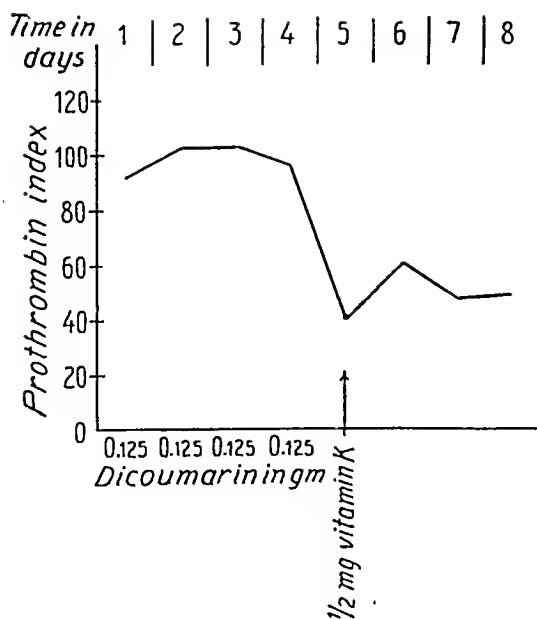
STIG BORGSTRÖM.

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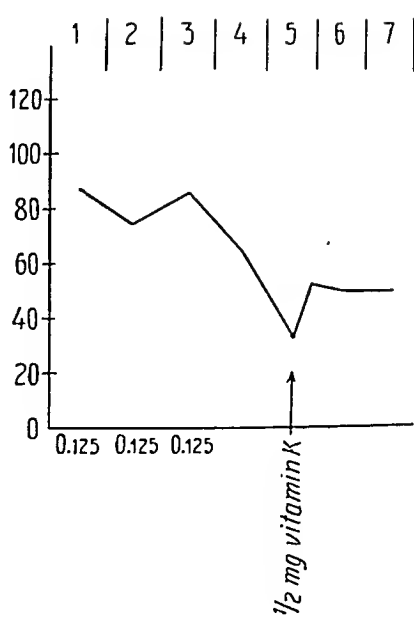
In the earliest works on dicoumarin it is pointed out that vitamin K is not able to shorten the prothrombin time lengthened by dicoumarin (BINGHAM and collab., 1941) or increase a prothrombin index decreased through dicoumarin (LEHMANN, 1942). In both these works, however, stress is laid on the unmistakable although rather transient effect of blood transfusion against a normalising of the prothrombin value. Yet, in a work published as early as only a few months after the former LEHMANN (1942) has been able to prove that doses of 100—200 mg water-soluble vitamin K per os give an increase of the prothrombin index after 3—12 hours. These large and even larger doses of vitamin K have been used in repeated dosage simultaneously with blood transfusions in the cases of dicoumarin poisoning with bleeding that are published in Swedish literature (ABRAMSON, 1943, FÅHRÆUS, 1943, and THORSÉN, 1945).

The most pronounced effect of vitamin K is obtained at low prothrombin values after small dicoumarin doses. The quantity of vitamin K recommended varies between 50 mg to gm doses, possibly in repeated dosage when a secondary fall of prothrombin index occurs (TAGE-HANSEN and JANSEN, 1947). In the thrombotic treatment and the post-operative thrombo-prophylaxis with dicoumarin given at the Surgical Clinic, Lund, we have, however, found that considerably smaller doses of vitamin K can be used to advantage in order to increase not desirable decreases of the prothrombin index.

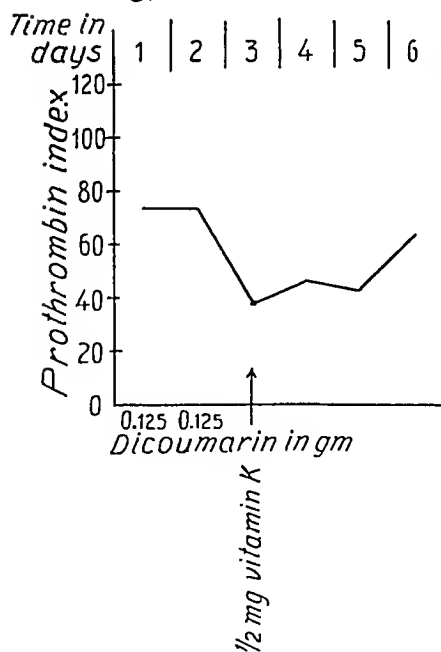
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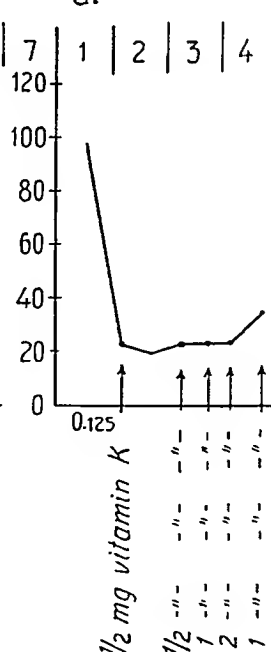
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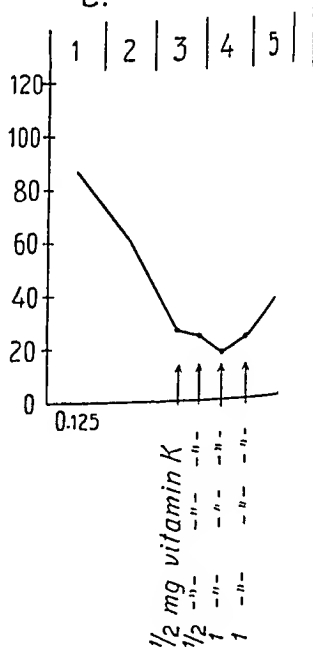
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e.



The dicoumarin dosage follows in the main BRUZELIUS' (1945) indications. In cases of diagnosed thrombosis or embolism heparin is, however, given simultaneously with dicoumarin until the prothrombin index is below 60-index units. The treatment is then



continued solely with dicoumarin. In thrombo-prophylaxis, which begins the day after operation, as well as in therapy there is never given a larger initial dose than 0.25 gm dicoumarin. To old debilitated patients, patients with large wounds and where one has or can expect difficulties with the intestinal passage the initial dose is 0.125 gm. If the prothrombin index shows no or an insignificant decrease on the following day the patient gets a further 0.125 gm dicoumarin and thus is proceeded until the prothrombin index is below 60. Is the decrease on the other hand considerable but has not yet reached an index value of 60, the following day's prothrombin value is expected without the patient's getting any further dicoumarin. Has the prothrombin index not decreased on the following day to 60 units, a further 0.125 gm is administered. We make efforts to keep the prothrombin value between 60 and 40 index units. The administration of dicoumarin can be said to be extremely careful. Nevertheless one often gets unexpected decreases of the prothrombin index owing to the different sensibility of different individuals. It is not seldom that even the same individual reacts differently on separate occasions to the same dosage of dicoumarin. If one gets a violent fall of the prothrombin index to below 40 units but no bleeding, it is most suitable for the continued treatment if the fall is stopped and one gets a slight increase of the prothrombin value. This can generally be obtained with very small doses of water-soluble vitamin K that is supplied per os. In these cases we use  $\frac{1}{2}$ —2 mg vitamin K. The curves in fig. 1 exemplify what has been said above: a—c show how in cases of a rapid decrease to slightly below 40 index units this decrease is controlled with  $\frac{1}{2}$  mg vitamin K per os, the prothrombin index rises but lies on the following days on a desired prophylactic level. In the curves d and e a decrease of the prothrombin index to between 20 and 30 has turned up after a small once-occurring dose of dicoumarin.  $\frac{1}{2}$  mg water-soluble vitamin K is supplied per os. The prothrombin index is controlled after another four hours. The fall of the prothrombin index has been stopped. A further  $\frac{1}{2}$ , 1 or 2 mg vitamin K is supplied and a slow, even rise in the prothrombin curve is obtained.

Small vitamin K doses can show themselves sufficient even after large dicoumarin over-dosage. A 56-year-old man comes to the Clinic with macroscopical haematuria and thrombosis in his left calf and thigh. He had got 1 A. P. tablet  $\times$  3 for two days

and 1 A. P. tablet  $\times 2$  for another two days. On his arrival the prothrombin index was 16. The patient was given 1 mg. vitamin K on the day of his arrival and 2 mg on the two following days. On the 4th day the prothrombin index was 43. The haematuria had disappeared and the treatment against the thrombosis could be prosecuted. It should be added that the patient's bleeding was not so excessive that blood transfusion was needed.

### Summary.

In cases of low prothrombin index values under a careful dicoumarin treatment in not bleeding patients who are under perpetual supervision, doses of vitamin K of  $\frac{1}{2}$ —2 mg are sufficient to interrupt a too violent decrease of the prothrombin index and increase it to a desired therapeutical level.

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## Paroxysmal Spontaneous Hypoglycemia Treated by Subtotal Resection of the Normal Pancreas.

By

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Hyperinsulinism is the most common cause of serious spontaneous hypoglycemic attacks. Other possible causes of similar hypoglycemia are v. Gierke's disease, liver- adrenal- and hypophyseal diseases and certain brain disorders.

The following lesions in the pancreas can be found in paroxysmal hypoglycemia.

1. Adenomata (insuloma sive insulinoma) which are usually benign and can be:
  - a) large, solitary, varying in size from a bean to a walnut,
  - b) small, solitary or multiple, eventually only microscopically visible.
2. Cancer — a Langerhansian carcinoma — where the metastasis similar to the primary tumor are capable of producing insulin.
3. Hypertrophic-hyperplastic pancreatic tissue without a tumor.

Microscopically normal pancreas tissue, removed by operation, and macroscopically normal tissue in the remaining part of the pancreas does not justify the conclusion of normal pancreatic tissue throughout. It is quite possible that small adenomata are present in the part left on operation (DAHL-IVERSEN). An insuloma in an aberrant pancreas is also a conceivable possibility (FANTA).

A case recently diagnosed by one of us (A.) and operated upon by the other (W.) seems worthy of brief mention.

*Case history:* A 36-year-old farm labourer was admitted in an unconscious state to the Medical clinic on May 11, 1946. The patient who had formerly been in good health had been troubled during the last 4 months by 8—10 acute attacks of unconsciousness, usually occurring

in the morning with a maximal duration of 10—15 minutes. These spells usually took place in the morning following manual work, when he had begun to feel hungry: by giddiness, sweating, great pallor, and within a few minutes a state of confusion. At this point amnesia set in. He used to go in from his work with an unsteady gait, lie down and would be there groaning, restless and thrashing about. After 10 minutes he usually quieted down but he was still slightly confused. Ordinarily after half an hour he was conscious but he was still unsteady on his feet. Sometimes he was troubled during the next few hours by a severe headache.

On the morning of his admission, the patient experienced a customary attack. The symptoms, however, did not disappear as usual but the patient became more and more muddled and at times he had motor disturbances. A local doctor made the probable diagnosis of cerebral haemorrhage or cerebral tumor, administered morphine and sent the patient to the hospital.

On his arrival at 10 o'clock in the evening the rather thin but well-built man was completely unconscious without any definite evidence of paresis or reflex derangements and also without any noteworthy symptoms.

An immediate blood sugar analysis showed a blood sugar content of only 30 mg%. After intravenous administration of glucose the patient began to move, cough, open his eyes and look around in a confused manner. He could not, however, answer questions. After a relatively short period the patient again became apathetic. A new glucose injection had the same effect as the previous one. Two hours later the blood sugar was 50 mg%, whereupon the patient was given glucose again together with adrenalin.

The morning following admission the blood sugar was 80 mg%, the patient was clearer but did not answer when addressed. The right arm appeared to be somewhat paralyzed. After intravenous glucose administration the patient became brighter and was also able to move his right arm, although he still did not reply to questions. During the day he lay apathetic, but nevertheless, he was able to consume a considerable amount of sweetened liquids. In addition he received several intravenous injections of glucose. The blood sugar at 12 o'clock was 50 mg%, at 3 P. M. 110 mg% and at 7.30 P. M. 130 mg%.

On May 15 the blood sugar was 50 mg%, sugar and water were administered orally and repeated intravenous glucose injections were given, about 200 mg% during the day. During subsequent days patient received food early and had no symptoms of hypoglycemia. The fasting morning blood sugar values were still low, between 40—80 mg%, the evening values between 110—160 mg%. During the latter part of this period the patient received a normal diet without extra additions of sugar. On one occasion he developed a slight hypoglycemic condition in connection with fasting while awaiting a roentgen examination. After the administration of glucose intravenously the roentgen examination could be carried out without difficulty.

*Roentgen examination:* The stomach — with gas inflation according to Fischer's method — showed no signs of any expansive process in the region of the pancreas. The usual liver-function test indicated a normal state. There were no signs of adrenal derangement, digestive disturbances or of v. Gierke's disease. Roentgen examination of the hypophyseal region also showed normal conditions. The neurological examinations, as well as the electrocardiogram, showed nothing of note.

Oral administration of glucose, 1 gm. per kg. body weight, gave an initial fasting value of 30 mg% and a maximum of 240 mg% after 1 $\frac{1}{4}$  hours. The test will not be further discussed: "Much work has been done in the way of blood sugar curves, glucose tolerance tests, injection of adrenalin and insulin, but hitherto these methods have failed to supply a reliable assistance in the differential diagnosis of the possible causes of hypoglycemia". (cit. KJÆRGAARD, 1944).

*Summary:* a case with spontaneous attacks of hypoglycemia characterized by a hyperinsulinism is reported. Roentgen examination did not support the hypothesis of a larger tumor in the pancreas, but naturally such a possibility could not be excluded.

The experience and progress of ALLEN O. WHIPPLE and ALEXANDER BRUNSCHWIG during the last 5 years especially regarding the operative treatment of pancreatic tumors (carcinoma of the pancreas) have made us more familiar with the technique and pre- and postoperative treatment of partial and total extirpation of the pancreas, and permitted us to perform such operations with technically good final results.

A series of such cases where larger and smaller parts of the pancreas have been extirpated have been reported (KJÆRGAARD, WHIPPLE, H. FR. HARBITZ and others). The final result, as far as it is already evident has varied with respect to the hypoglycemias. Several of these cases have upon extremely careful pathological anatomical examination shown completely normal pancreatic tissue.

According to experience up to now, the amount of pancreas removed in the latter cases plays an important part in the final result. V. C. DAVID has shown in a larger survey that in 18 cases, in which 8—28 gm. pancreatic substance were removed, 3 were healed, 3 improved, 8 unimproved and 8 had died. In 17 cases with subtotal extirpation of the pancreas from 35 gm. up to 90 % of the gland 11 were healed, 1 improved, 4 unimproved, 1 had died. In those cases therefore where no defined pancreatic tumor can be found in spite of careful exploration during the operation and where the symptoms are serious a markedly radical extirpation of the pancreas (at least  $\frac{3}{4}$ ) should be performed. In doing so there are chances of eliminating any insuloma which has not been observed as well as removing so much of the glandular substance that a possible hyperfunction is thereby reduced and an improvement in the hypoglycemic attacks takes place.

*Operation June 6 (WULFF): Laparotomy + Subtotal Extirpation of the pancreas.* More than  $\frac{3}{4}$  of the pancreas was removed: weight of the preparation 38 gm.

Lumbal anaesthesia with percain according to Seebrecht. In addition N<sub>2</sub>O-oxygen and narcotal intravenously. Incision below and above the navel. In the mesentery and the mesocolon there were a few, smaller, acutely swollen glands and for the rest nothing of note. Nothing abnormal was observed in the stomach, duodenum, and other small intestines, liver, spleen or colon. The lesser omentum was opened and the gastrocolic ligament divided so as to obtain an unobstructed view of the pancreatic region and good possibilities for an extensive palpation. In spite of the most careful palpation and inspection of the head of the pancreas as well (bilateral palpation) no insuloma was observed or palpated.

In view of the conditions in similar cases it was decided to perform a radical extirpation of the pancreas. Through the opening in the lesser omentum extirpation of the pancreas was then carried out so that the cranial and caudal edge exactly in the region of the head of the pancreas was isolated. After careful tunneling a curved forceps could be pushed behind the pancreas without any bleeding, after which the gland was lifted up and divided so that  $\frac{1}{4}$  to  $\frac{1}{5}$  of the pancreas (the head) was left on the right side while the rest was on the caudal side. The duodenal pancreatic stump could be completely closed and invaginated. A special silk ligature was applied to the pancreatic duct. After that the pancreatic body was removed carefully, centimeter by centimeter, during which special attention was directed to the splenic arteries and their branches. Finally the last connective tissue bundles at the caudal extremity of the pancreas could be ligated and the pancreas removed. The weight of the preparation was 38 gm. A fine rubber tube was inserted near the pancreatic stump through the lesser peritoneal sac for drainage. During the operation glucose drops and 2 blood transfusions of 450 ml. were given.

The postoperative reaction the first 3 days was fairly pronounced, but the subsequent course was on the whole mild. On July 1 a definite but mild embolic attack could be ascertained. After July 17 the condition of the patient was quite normal.

Urine diastase determined by Wohlgemuth's method was 256 units; the first and second days following the operation, 128, on the third day and later between 32 and 16. The urine excretion varied between 900 and 1200 ml per 24 hours. Serum albumin remained between 6.9 and 5.5 % and serum chlorides between 306 and 220 mg%.

The pancreatic substance which had been removed was investigated carefully in its entirety. The pancreas was cut in mm. thick sections. The pathological-anatomical examination by microscopy



showed fully normal pancreatic tissue. No insuloma was evident (MELLGREN).

On control examinations until February 1948, almost 20 months after the operation, the patient has felt fairly well. Sometimes however, about twice a week, he has slight symptoms of hypoglycemia but after taking a couple of lumps of sugar his condition becomes normal. He has not increased in weight. Normal fasting blood sugar. — It is still too early to say anything definitely about the prognosis of the case, even if the last 20 months indicate favourable course.

As far as the *operation* is concerned it appears from this case as well as others that lumbar anaesthesia is convenient, but intubation anaesthesia in addition to curare as well as other anaesthesia methods are also suitable. The method of approach — through the lesser omentum or via the gastrocolic ligament—depends upon the existing conditions. It is essential that there is *extremely good access to the region of the operation as the least carelessness in this respect can mean that a minimal insuloma is allowed to remain*. Isolation of that part of the pancreas which is to be resected is accomplished most readily by tunnelling behind the gland at an appropriate spot which has also been suggested by HARBITZ. Cutting off the gland takes place between 2 clamps and after this removal with the clamps as suitable means of drawing the distal section of the pancreas. In this way one obtains a good view over the blood vessel supply and is able to avoid disturbances in the blood supply. This technique can also be used in total extirpation where one works in both directions from the central opening.

### Summary.

A case of paroxysmal, spontaneous hypoglycemia existing for 4 months in a 36-year-old man is described. The patient arrived at the hospital in an unconscious state. No tumor could be shown in the pancreas upon operation. More than  $\frac{3}{4}$  of the pancreas was removed. Microscopic examination showed normal pancreatic tissue. 20 months after the operation the patient is still fairly well; sometimes, however, he has slight symptoms of hypoglycemia.

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## Results of Partial and Total Gastrectomy in Cancer of the Stomach.

By

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In recent years total gastrectomy for cancer of the stomach has become more and more common in Sweden, and comparatively small series showing some striking primary results have already been published. Yet only a few years ago, surgeons were frequently warned against attempting this operation because of the high primary mortality and generally bad results obtained, in spite of the more radical approach. FOGED published an extensive study of the literature in 1945.

The author has collected the cases of cancer of the stomach which were operated on in different ways at the Central Hospital in Gävle from 1929 to 1940 in order to compare the end results of a series of total gastrectomies (the primary results of a number of which were published in 1936 in a lecture by EM. LANDELIUS) with the results of some less radical operations. He has also had at his disposal material on the total gastrectomies done in recent years at the Military Hospital in Boden.

The material from Gävle comprises 172 cases. Exploratory laparotomy was done in 58 (42 men, 16 women) = 34 %; gastroenterostomy or the like in 28 (18 men, 10 women) = 16 %; partial resection in 73 (52 men, 21 women) = 42 %; and total gastrectomy in 13 (11 men, 2 women) = 8 %.

The primary mortality figures are not always correct in the inextirpable cases. 4 of the group who underwent exploratory laparotomy died in immediate connection with the operation or

*Results of Different Operations for Cancer of the Stomach.*

	Exploratory Laparotomy	Gastro-Enterotomy	Billroth I Resection	Billroth II Resection	Total Gastrectomy
Total No. ....	58	28	13	60	13
Prim. Deaths ....	6 (10 %)	9 (32 %)	3 (23 %)	14 (23 %)	7 (54 %)
Living After					
3 Yrs. ....	0	0	3 (23 %)	19 (32 %)	2 (15 %)
5 Yrs. ....	—	—	3 (23 %)	15 (25 %)	1 (8 %)
10 Yrs. ....	—	—	2 (15 %)	8 (13 %)	0

*Results of Partial and Total Gastrectomy in Men and Women.*

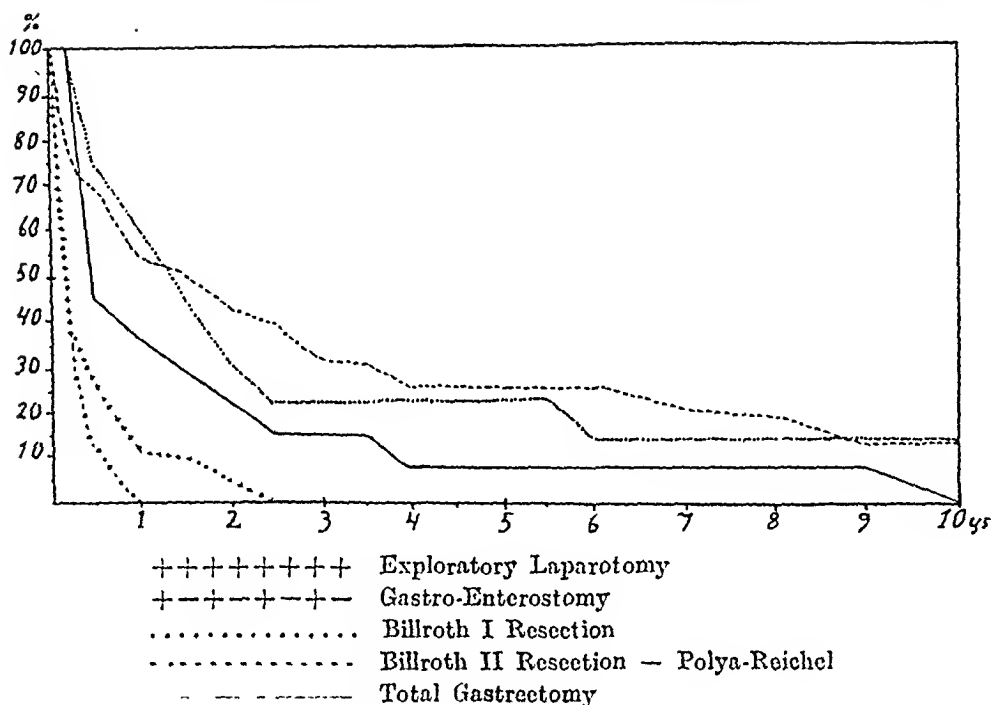
	Primary Deaths	Secondary Deaths	Living After 5 Yrs.	Total
Men .....	20 (32 %)	29 (46 %)	14 (22 %)	63
Women ....	4 (17 %)	14 (61 %)	5 (22 %)	23
	24 (28 %)	43 (50 %)	19 (22 %)	86

*Results of Partial and Total Gastrectomy at Different Ages.*

Age Range	Primary Deaths	Secondary Deaths	Alive After 5 Yrs.	Total No. Cases
20—29 yrs. ....	1 (100 %)	—	—	1
30—39 .....	—	2 <sup>1</sup> (40 %)	3 <sup>2</sup> (60 %)	5
40—49 .....	3 <sup>3</sup> (21 %)	7 (50 %)	4 (29 %)	14
50—59 .....	8 <sup>4</sup> (25 %)	19 <sup>1</sup> (59 %)	5 (16 %)	32
60—69 .....	10 <sup>3</sup> (33 %)	14 (47 %)	6 <sup>5</sup> (20 %)	30
70—79 .....	2 (50 %)	1 (25 %)	1 <sup>6</sup> (25 %)	4
	24	43	19	86

<sup>1</sup> One died of another disease. Postmortem: no cancer.<sup>2</sup> One died of cancer after 7 years.<sup>3</sup> 2 total gastrectomies.<sup>4</sup> 3 total gastrectomies.<sup>5</sup> 2 deaths from cancer after 6 and 7 years.<sup>6</sup> Death from another disease after 6 years.

of complications; the others had to remain as cases requiring special care. On the other hand, some died very soon after returning home. The tables show the well-known higher mortality rate for men and the usual proportion between men and women. It is noteworthy that the end results are not poorer for the younger age groups, in spite of the fact that the cancer is considered more malignant in these years. (ANSCHÜTZ states, for example, that only



According to the Swedish Statistical Yearbook (Svensk Statistisk Årsbok) for the year in question, 93 out of 100 40-year-olds and 30 out of 100 70-year-olds are alive after 10 years.

5 % of patients under 40 survive 5 years, as opposed to 18 % between 40 and 60 and 28 % over 60.) But the author's material is not extensive.

The curves above give the percentage of patients alive after a certain number of years after the operation in each of the five groups.

*Of Those Who Underwent "Radical" Operations and Were Discharged from the Hospital, the Following Percentages Lived the Indicated Number of Years.*

Method of Operation	3 Years	5 Years	10 Years	Discharged
Billroth I .....	3 (30 %)	3 (30 %)	2 (20 %)	10
Billroth II etc. ....	19 (41 %)	15 (33 %)	8 (18 %)	46
Total Gastrectomy..	2 (33 %)	1 (16 %)	0	6
	24 (39 %)	19 (31 %)	10 (16 %)	62

All series operated on within the same year were followed at least 6 years. Thereafter the most recent series were gradually excluded, so that the figures are always proportional. The longest

period of observation was 18 years (in 2 cases). Very high subtotal resection was done in 12 cases, with 38 % primary mortality and 1 surviving 5 years. In 3 cases, resection of a part of the transverse colon was done simultaneously with partial resection of the stomach; there were 2 primary deaths and the other patient lived  $7\frac{1}{2}$  years.

Cardiac cancers, in which only laparotomy or gastrectomy was done, and perforated cancers of the stomach, which also were not operated on "radically", are not included here. One case of the latter survived almost a year. Another excluded case was diagnosed as juxtapyloric ulcer, but when the stomach was being freed for resection a non-resectable cancer was found located high up in the corpus. Freeing the stomach had then proceeded so far that it was considered necessary to resect the lower portion, where the lesion was also found. (A similar case is included among the total gastrectomies.) 2 other excluded cases were operated on following diagnosis of cancer of the stomach, but nothing abnormal was found. 1 of these died of cancer, according to the death certificate, about a year later, and the other 6 years later of another disease. On the other hand, all cases have been included in which an operation was undertaken following a diagnosis of ulcers and in which the histological examination was perhaps first to show cancer, as well as 1 case in which gallstones were suspected before operation.

Of the 172 cases, 87 (50 %) have thus been regarded as suitable for "radical operation". 13 of these (15 %) have been resected according to Billroth I; 60 (70 %) according to Billroth II or Polya-Reichel; and 13 (15 %) subjected to total gastrectomy. The distribution and results correspond approximately to the Scandinavian statistics in recent years. Thus we have HOLST, 1942: 255 operations, 50 % of them radical (12 "total", or rather, subtotal gastrectomies, since the cardiac ring was retained, and 115 partial) as opposed to 32 % exploratory laparotomies and 18 % palliative operations. The primary mortality in ordinary partial resection was 20 % and in "gastrectomy" 32 %. 21 % of the resected were alive after 3 years and 10 % after 5. HEDLY, 1944, reports 400 operations with 40 % resections (60 % during the last decade) as opposed to 45 % exploratory laparotomies and 15 % gastro-enterostomies. Primary mortality during the past decade: 38 %. 5 year cure: 9 %—18 % of the resected. Here resection was also done deliberately as a palliative operation (that is, in order to mitigate discomfort in cases which might otherwise have been labelled inoperable) and extensive gland removal and resection of adjoining organs were also undertaken, circumstances which

naturally led to poorer results. SANDBERG, 1946, reports 253 operations, 43 % of them radical (17 total and 5 subtotal gastrectomies, 4 cardiac resections, 4 with simultaneous resection of the transverse colon), and a total mortality of 25 %. WESTERLUND, 1946, reports 156 operations, 45 % of them radical resections, with 37 % primary mortality and 5 year cure of 19 % (1 case only 4 years). In 1942, WALTERS, GRAY & PRIESTLEY summarized 10,890 cases as 43 % inoperable, 22 % laparotomies, 10 % palliative operations, and 25 % resections, with a primary mortality of 16 %. 24 % of the survivors were cured after 5 years. In 1943, WANGENSTEEN had out of 43 cases 88 % resections with a primary mortality of 8 % in spite of simultaneous removal of the para-aortic lymphatic glands in several cases and liver resection in 4. In their large statistical summary of 1939, LIVINGSTON & PARK give series of well chosen cases with primary mortality as low as 5 %.

The primary results in total gastrectomy are considerably poorer, but have been improved a good deal recently, as is shown by an analysis based on the literature of the past 15 years.

Author	Yr.	No. Cases	Primary Deaths
ROEDER .....	1933	88	50 %
DECUING .....	1934	132	42
TATENO .....	1936		48
ALLEN .....	1936	15	46
LANDELIUS, EM. ....	1936	10	40
ABELL .....	1940		40
GOTÓ .....	1940		30
GRAHAM .....	1941	19	74
JACKSON .....	1941		40—50
HOLST (subtotal) .....	1942	12	33
RÖDÉN .....	1943	6	67
HORSLEY .....	1943	3	0
FARRIS, RANSOM & COLLIER .....	1943	19	10.5
JONES & KEHM .....	1945	8	0
NICOLAYSEN .....	1945	15	47
LONGMIRE .....	1947	20	10
WAHREN .....	1947	9	0

The 13 cases from Gävle are 11 men and 2 women between 42 and 64 years of age. 3 had a relatively limited cancer which could have permitted of partial resection, 2 a cancer located high, near the cardia (1 of these was operated on for duodenal ulcer and the tumor was first discovered upon operation), and the

others a more extensive cancer in the canal region, in which in the majority of cases total gastrectomy was the only possibility, 4 of the 7 cases of primary death were due to sutural insufficiency (1 of them with mediastinitis), 1 to peritonitis, probably resulting from leakage during the operation, and 2 to acute pancreatitis. In 1 other, who survived, roentgen revealed a suspected fistula at the anastomosis. (See section on *Postoperative Examinations*.)

The end results are not remarkable. 2 lived 3 years, 1 of them more than 5. The latter died after barely 9 years of cancer of the rectum. In 1943 PACK showed in a table of 303 total gastrectomies with a primary mortality of 37 % only 5 % living after 5 years, and in 1945 FOGED knew of only 2 cases in the literature who survived more than 5 years (1 of them 9½, ELVING).

The material from Boden includes 24 total gastrectomies with 4 primary deaths (17 %). 1 of these, however, was operated on in a different manner. The other operations were done according to the same method, with 3 resultant deaths (13 %). Upon microscopic examination 3 were found to have a calloused ulcer located high up against the cardia (1 primary death), 1 sarcoma, 1 adenopapilloma and the others cancer. Thus 2 (10 %) of 20 gastrectomies for tumors of the stomach carried out in the same way led to primary death.

The only cases regarded as inoperable have been those with distant metastases. No doubt many who underwent total gastrectomy would have been regarded elsewhere as inoperable, since resection was impossible except in 1 case, in which, however, examination of the specimen revealed gland metastases so high up that a resection could not be regarded even here as a radical operation. In 1946 and 1947 13 total gastrectomies and 9 resections were done, but only 2 of the latter because the cancer was located far down without metastases. The other 7 were undertaken because of contraindications in the form of fatness, a stomach difficult to get at, etc. Thus because of the extent of the indications for gastrectomy, less favourable results are to be anticipated. In the gastrectomies carried out in the same way, the deaths were due to sutural insufficiency (1), anesthesia complications — loss of blood pressure with anemia of the brain and death from pneumonia — (1), ileus due to too short a loop (1 with calloused ulcer) and, in the specially operated case, to sutural insufficiency resulting from tearing after an attack of coughing.

### Technique of Operation.

In the cases from Gävle, the operations were done with local and splanchnic anesthesia, with ether toward the end. Median incision. Most of the omentum was also taken. A right-angled clamp, but no holding suture, was placed on the esophagus after the latter had been mobilized at least 2 cm. above the cardia. Anastomosis was made in various ways, as follows:

esophago-jejunostomy only .....	3	primary deaths	1
»       »       plus splenectomy .....	1		1
»       »       »   jejunostomy (Witzel) .....	2		1
»       »       »   entero-anastomosis .....	1		1
»       »       acc. to Roux .....	2		1
»       »       »   »   » plus jejunostomy ...	4		2

In 1 case the esophagus split lengthwise when it was sutured, and since in other cases, too, the sutures seemed to have a tendency to cut through lengthwise, an attempt was made to place them across the lengthwise streaks. The sutures were of readily resorbable catgut, without mucous suture. In Y-anastomosis according to Roux, the jejunum was drawn up around the esophagus stump like a cuff in order to protect the anastomosis. In all cases, the loop of the jejeunum was drawn behind the colon and the incision closed afterwards with catgut sutures above the entero-anastomosis (if any). In 6 cases a Witzel jejunal fistula was made for nourishment and relief. The wound closed primarily except in 4 cases, in which drainage was undertaken because of bleeding or leakage during the operation. All of these had sutural insufficiency, but 1 survived.

Thus the general lines of Coenen's method were followed, but with these deviations: the jejunal loop was made longer, the mesocolon incision closed above the entero-anastomosis, the caliber of the jejunal lumen not reduced to that of the esophagus, the anastomosis invaginated and sewn with catgut only (no mucous suture), the jejunum not fixed against the diaphragm, and clamps but not holding sutures used on the stump of the esophagus.

High percain anesthesia, sometimes supplemented, was administered to the Boden cases. As much as possible of the omenta and glands were removed and here too gastrectomy was always total. In 1 case esophago-duodenostomy was undertaken, but the

patient died as a result of sutural insufficiency (see above); in the other cases, esophago-jejunostomy was done with a long loop in front of the colon after the esophagus was carefully mobilized. Only interrupted nylon sutures were used. The posterior suture row was made before the esophagus was opened, whereupon half the esophagus was cut across with a cautery, the jejunum opened and half the anterior row (including the mucous layer) sewn before the remainder was cut off and the suture row finished. Thereafter followed 2 suture rows on the anterior side. Clamps and holding sutures were not used. Sometimes there was covering with the diaphragm. Entero-anastomosis was done in all cases.

In 1 case the operator removed an old gastro-entero-anastomosis with resection of the duodenum, which was sewn end-to-end; in another a colon resection, splenectomy, and resection of half the pancreas was done (discharged cured in 11 days); and in still another a splenectomy and large pancreas resection (death due to sutural insufficiency). Splenectomy was undertaken in 4 other surviving cases.

A close analysis of variations in the technique of operation was made by FOGED in 1945. The following observations are drawn from his and later publications. Anesthesia may be local or splanchnic, ordinarily with laughing gas or ether; lumbar; or cyclopropane. A carefully followed, not very deep narcosis with curare for relaxation would presumably be of great value in purely abdominal operations. The incision is usually median or left paramedian (ALLEN, LAHEY, HOLST and others), possibly with extirpation of the xiphoid process. Some operators, among them WAHREN, prefer incision along the left arch, possibly with rib resection or mobilization of the lowest rib (HILAROWITZ and MARWEDEL), while others advocate thoraco-abdominal operation (Japanese authors, GARLOCK, CHRISTOFFERSON, STRÖMBÄCK, and others), which may be the method of the future but requires access to thoracic surgical equipment and up to now has been used primarily in cardiac resections. Cardiac resection only and total gastrectomy have about equally high primary mortality (GARLOCK: 4 out of 9; SWEET: 15 % of 45), and there is still danger of recurrence in the part remaining.

To determine whether gastrectomy is possible, one should sever the suspensory hepatic ligament and hold the left liver lobe down (ALLEN, LAHEY). At this stage it must be decided whether the esophagus can be mobilized sufficiently, because individual



variations are great and according to FOGED all the cases in which it has been necessary to close the stump blindly and do a jejuno-stomy have resulted in primary death. Most doctors agree that the gastrectomy should be total. By retaining the cardia ring as HOLST does, and possibly part of the fundus also, the primary mortality is doubtless reduced, but the operation must then be regarded as a subtotal resection.

In gastrectomy the duodenum is divided and held down while the stomach is wrapped in a pad and retained as long as possible during the establishment of the anastomosis, partly because it is easier to bring the esophagus forward with its help and partly to reduce the length of time during which the lumen must be kept open (LAHEY, KONJETZNY, FOGED, and others). JONES and KEHM consider it better to remove the stomach before the anastomosis is made, however. One must be prepared for growths adhering to the pancreas, pancreas and colon resections, and extirpation of the spleen. Freeing for dissection should be begun near the colon. It is not necessary to preserve the blood supply to the greater omentum, which many operators remove to a large extent. Others agree with ALLEN that extirpation of the greater omentum is of lesser importance. The lig. gastrocolicum with glands must, however, be removed without injury to the middle colic vessels, which is easier if the stomach is brought forward so that the peritoneal reflection connecting its posterior wall with the lesser omentum is stretched and can be severed. As much as possible of the latter, with glands, is removed, due regard being paid to the bile duct and vessels. On the other hand, the author feels that there is not much point in trying, as a number of American surgeons do, to peel off the paraaortic lymph glands as well. This prolongs the operation unnecessarily without improving the end results, for when these glands too have been attacked by cancer, the spreading has doubtless gone too far already.

The decisive moment is then the mobilization of the esophagus. Preferably it should be freed 5—6 cm. The peritoneal serosa is dissected free (LAHEY and others), possibly in 2 flaps, a long distance distally around the hiatus, so that there will be good covering of the anastomosis later. The operator should dissect bluntly and carefully, possibly with a subperitoneal injection of cooking salt or local anesthetic solution (FOGED), at the same time that he pulls gently on the well wrapped stomach. Pulling too hard has led to death (VON HABERER). There is danger of in-

jury to the pleura and circulatory disturbance with gangrene in the lowest portion of the esophagus, possibly mediastinitis (1 of the Gävle cases). LONGMIRE calls attention to the presence of fibrous islands in the esophagus wall: these should be left intact to give firmness to the sutures, which may then show less tendency to cut through (1 of the Gävle cases). WAHREN emphasizes the importance of protecting the ascending branch of the left gastric artery, since the lower part of the esophagus depends heavily on this vessel for nourishment; this is accomplished first by liberating the vagus on the major side and severing it; dividing the peritoneum on the anterior and posterior sides; identifying the artery and freeing the cardiac region on the right side and ligating the vessel while protecting the ascending branch. Finally the right vagus is divided. By cutting off the vagus the esophagus is mobilized still further. According to LAHEY, one should not, as others have suggested, crush the left phrenic nerve in order to obtain temporary diaphragm paresis, because this increases the danger of pulmonary complications.

Opinions differ concerning the type of anastomosis to be preferred. Many have used the esophago-duodenostomy, as in the first Boden case (VON HABERER and others), but the risk is about twice as great as in esophago-jejunostomy, and since 1930 the tendency has been to prefer the latter. The advantages lie in less tension and a thicker intestinal wall. Both antecolic (KONJETZNY, HOLST, LAHEY, TROELL, the Boden cases) and retrocolic esophago-jejunostomy (COENEN, FINSTERER, ALLEN, BULL, the Gävle cases) have been performed. LAHEY considers that it is not even necessary to make an entero-anastomosis, while the others who prefer the former method and many who use the latter are accustomed to do so. An Y anastomosis according to Roux (6 of the Gävle cases) is seldom used (COENEN, MONT REID).

When making the anastomosis it is important to take a sufficiently long loop to avoid tension. This may be difficult. LONGMIRE sometimes divides one of the primary mesenteric arteries in order to make the loop sufficiently flexible. It may be that anastomosis according to Roux is indicated in just those cases in which the jejunal mesentery is short and the loop difficult to mobilize.

Otherwise the same technique which has been described by LAHEY, among others, and used by LINDVALL in the Boden cases may be used to advantage in making the anastomosis. While the

stomach is used to draw forward the cardia, a loop of jejunum is brought up to its posterior wall. 2 holding sutures may be used. The opening must be large enough to obviate the risk of excessive narrowing (LAHEY). Thereafter the jejunum serosa is attached by a row of sutures, preferably interrupted, to the posterior side of the esophagus. Many (including LONGMIRE and NICOLAYSEN) do not ligate these before all have been placed. The esophagus is opened afterwards with a short incision in 1 corner, a catheter introduced quickly, and the esophagus sucked empty while the stomach is kept closed. Thereafter the posterior edge of the incision is sewn to the corresponding incision in the jejunum with continuous or interrupted sutures, the esophagus incision being lengthened little by little. When the posterior rows are completed, the anterior wall of the esophagus is severed, the stomach detached and the operator sews the anterior wall in the same manner, possibly, like LAHEY, with the same continuous mucous sutures. Mucous suturing is usual but was not used in the Gävle cases. WAHREN always uses catgut in anastomoses (as was done in the Gävle cases) and LINDVALL in Boden only interrupted nylon. Last of all the peritoneal flaps should be sewn over to cover completely.

Many operators (FINNEY and RIENHOFF, ALLEN, GRAHAM, FOGED, and others) use a Levine tube which is placed in the stomach prior to operation and handled subsequently by the anesthetist. When the anastomosis is being made, the latter draws the tube up over it and keeps the esophagus empty by constant suction. When the anastomosis is completed, he guides the tube into the distal limb of the jejunum, where it is left for about a week to lead the saliva past the anastomosis and relieve it. Many surgeons (FINNEY and RIENHOFF, FOGED, GRAHAM) also use it to supply nourishment, but ALLEN warns against this, as it can easily be dislodged and is difficult to replace. Instead ALLEN constructs a jejunostomy, as do VON HABERER, FINSTERER, and others. The Boden cases show, however, that even this is rendered unnecessary by the immediate oral administration of liquid (see below).

The majority of operators warn against using clamps on the esophagus, but a number (NICOLAYSEN, EM. LANDELIUS) employ them to close the stump temporarily. WAHREN zigzags an ordinary twined steel wire through the lower end of the esophagus so that it closes the lumen. Then he holds the lumen stretched on the wire by means of holding sutures on each side.

In barely half of the cases (FOGED), the primary mortality is due to peritonitis resulting from leakage during the operation or sutural insufficiency afterwards. The operator seeks to avoid the former by the shortest and least possible opening of the lumen, as above, and the latter by drawing the jejunum over the anastomosis like a cuff or by following GRAHAM's method. GRAHAM locates the anastomosis on the anterior side of the descending left loop somewhat below the top, draws the right, ascending loop around it in front like a coat, and then sews them together on the sides. Entero-anastomosis is of course necessary afterwards. RÖDÉN has used this method to good effect. Finally the mesocolon incision is closed; this may well be done above the entero-anastomosis, if any. The majority of surgeons close the abdomen primarily and drain only if specially indicated; others drain on principle (FOGED, NICOLAYSEN), since considerable secretion must be expected in operations of this type. FOGED and others dust the operation site intra-abdominally with sulfathiazol.

All writers emphasize the importance of not giving the patient anything by mouth for the first few days after the operation. The correctness of this point of view is disputable, however; there is in any case continuous secretion in the oral cavity, which ought rather to be encouraged, and a continuous flow through the esophagus with great possibilities of infection, doubtless considerably greater than those associated with the giving of reasonable amounts of water or the like by mouth. The Boden cases have all been given fluids by mouth from the day of the operation. Provision must likewise be made for an ample parenteral supply of liquid, either by the immediate administration of intravenous drip or regular intravenous administration of liquids or blood combined with careful control of the fluid balance. WAHREN also gives aminosal. Special consideration must be given to serum albumin, inasmuch as the function of the liver is affected and the production of serum albumin in particular reduced (ACKERMAN and REGATO). In the Gävle cases the patients were not permitted to drink during the first week, but soon afterwards, as in the Boden cases, they were put on more solid food and when discharged were usually eating 6 meals per day of varied food. Occasionally hydrochloric acid has been given. LINDVALL emphasizes the importance of the patients' being up soon after and also before the operation, as a prophylaxis against postoperative

complications, and the Boden cases have for the most part been discharged at most 2 weeks after the operation.

1 of these Boden patients illustrates how well a person may be after this extensive operation. He had a little fever on the third day, but was permitted to sit up for a while after the drip treatment. On the morning of the fourth day he came to meet the doctors' round "to thank them for the operation".

## Postoperative Examinations.

The Gävle patients who are still living have answered a questionnaire and the majority have submitted to postoperative examinations.

I. Stomach Resection Billroth I (1929—1933): 13 cases. 1 patient died after 6 years, of heart failure; 2 are still alive after 18 years, 72 and 88 years old. The former reported for examination, had been fully employed, and was in good general condition. Occasionally he had sharp abdominal pains which he "cured with a little drink." Hemoglobin 80 %; erythrocytes 4.2 million. Of the remaining 7 who were discharged, 2 were operated on for further difficulties after  $3/4$  of a year and  $2\frac{1}{2}$  years, respectively, and were found to have inextirpable stomach recurrences.

II. Stomach Resection Billroth II etc. (1930—1940): 60 cases. Out of 26 secondary deaths from cancer, X-ray or operation revealed recurrence in the stomach in 3 who reported to the doctor because of further difficulty. 1 of these lived  $7\frac{1}{2}$  years after the resection, 3 years after the recurrence was discovered, and another  $6\frac{1}{2}$  years. 2 patients died after 1 year of another disease, and the postmortem showed no cancer. Of the 12 still living (according to information received from the parish clerks), 2 have not answered and 4 have answered by letter. They feel well and are fully employed, but sometimes they have a little difficulty after large meals. 6 have been examined more thoroughly and show good general conditions without any signs of recurrence. Moreover, they are as capable of work as their ages permit. Some have to eat small meals, 1 gets diarrhoea from food of milk, and several feel that they cannot take milk as well as before. The majority show a moderate degree of anemia with the following blood values:

Hemoglobin .....	50	70	79	80	102	%
Erythrocytes .....	3.7	3.4	3.9	3.9	5.0	mill.

1 of them has typical pernicious anemia (which came to light before the operation, however) and has been anemic for 20 years. In all 6 cases X-rays showed the usual type of resection stomach (anastomosis without decrease of the cross section of the stomach) and rapid emptying, which thus, as after resection for ulcers (BRUN and EM. LANDELIUS), causes no difficulties worthy of mention.

III. Total Gastrectomy (Gävle): 13 cases. 7 died primarily, 1 after barely 3 years and 1 after 9. The last-named contracted cancer of the rectum 6 years later and refused another operation. His general condition was good for many years, but when he was given a check-up examination after 8 years he considered that he had never been capable of work and said he had had abdominal trouble the entire time, with loose bowel movements, often soon after eating. 2 years after the operation anemia was found which gradually revealed itself to be pernicious in type and was treated with good results by iron and liver preparations. Unfortunately no values were found before operation. An X-ray after 8 years showed good passage into widened jejunum loops, in which barium was still to be found after 4 hours. After 24 hours barium was found in the lower ileum and caecum. Our information on the others who underwent gastrectomy and died secondarily is more incomplete. 1 had a certain degree of stricture of the anastomosis with dilatation of the esophagus, and needed to eat smaller and more frequent meals, while another had a little pocket indicating the remains of a small sutural insufficiency with fistula. 1 died of "cancer of the stomach, paralysis cordis", (the death certificate) after 6 months; 3 lived  $1\frac{1}{2}$ — $2\frac{1}{2}$  years; and 1,  $3\frac{3}{4}$  years. 3 of them were seen after a time. 2 had begun to work on their farms after 4—5 months, while the third, who came back only once, after 4 months, had not begun to work at that time. All were in good general condition and had very good blood counts — hemoglobin 70 % —75 % and erythrocytes c. 3.7 mill. After 6 months 1 of them had metastasis in the abdominal scar, which was removed.

IV. The postoperative examination period is too short for the Boden cases subjected to gastrectomy. Of 20 operated on in the same manner for tumors, 2 died primarily and 8 secondarily, 5 of the latter within a year and 3 within  $1\frac{1}{2}$  years. 1 of these had recurrence and metastases and the others metastases. 3 are still alive 2 years after the operation and are well and fully cap-

able of work; 2 are alive after barely 1 year; and 2 after 6 months. 3 were operated on very recently. Several have had X-ray examinations and show good passage, except 3 with definite recurrences (now dead). Ordinarily one sees a dilatation of the uppermost jejunum loop into a small receptacle resembling a ventricle, but there has never appeared to be any slowed intestinal passage worthy of mention. The patients had no intestinal difficulty and could eat food of all kinds (until metastases developed). Only 1 has shown signs of pernicious anemia. Most of them have begun to work after a few months.

In the literature, difficulties after total gastrectomy are usually alleged to be slight. Out of LONGMIRE's 10 cases, 4 men returned to their work and 2 women to their households about a year after the operation; of the remainder under observation for less than a year, 2 had begun to work and 2 had not. All had gained weight, but not a great deal. The majority needed smaller, more frequent meals and were troubled by a feeling of fullness, while some felt a burning pain in the pit of the stomach a short time after eating. LONGMIRE calls particular attention to the necessity of observing these patients closely during the first few months. He lost 2 who showed signs of inanition and dehydration without any demonstrable cause other than that they could not manage their diets. In a few days they declined from a relatively good general condition to a moribund state and could not be saved. Similar instances have been described by TRINKLER, MIYAGI and ALLEN. The Gävle patient who was reported dead of heart failure after half a year might also belong in this class.

Various American writers (LONGMIRE, PACK & RHOADS, DIÁZ, RIBEIRO, MENDOZA & VIVANCO) have called attention to the excretion of large quantities of fat in the stools in these cases. The fat is digested, but resorption is unsatisfactory. Otherwise the stools are normal. BULL & STANG had a patient with slight anemia and somewhat increased protein and fat losses. FARRIS, RANSOM & COLLIER, on the other hand, in their long series believe themselves to have found that the stomach plays only an insignificant part in fat and protein digestion. The case is otherwise with iron assimilation, and glucose absorption occurs more rapidly, with a brief hyperglycemic and later hypoglycemic phase. Thus one should give these cases a high protein, low carbohydrate diet. They find the motility of the stomach-intestinal canal rather reduced than otherwise, which might be due to the

high severing of the vagus. The topmost jejunum loop is often widened, as in the author's cases, and the barium stays there longer, a condition which on the whole is of benefit to the digestion.

Many consider the danger of postoperative anemia less great than it was formerly felt to be. A certain degree of secondary anemia does indeed arise, but it is easy to keep the patients' blood counts normal by giving all of them iron after the operation (LONGMIRE). ALLEN considers that the anemia which was often described before is due largely to the tendency of these patients to avoid meat and subsist largely on liquids. Nevertheless several cases have been published in which, as in the Gävle cases described above, anemia of a pernicious type gradually developed; this type of anemia usually comes only after 2 years or so (HARTMAN, MEYER, NICOLAYSEN). Most of the American authors referred to above have too short an observation period. The pernicious anemia, which seems to respond well to liver and iron therapy, does not always develop, however, and should not be confused with the rather similar blood picture which may be found in connection with cancer metastases (ASK-UPMARK and others). A number of clinicians also believe there is a connection between gastrectomy and pernicious anemia (BAUMECKER, BREITENBACH, DENNING) and examinations of animals (PETRI, BING & NIELSEN, among others) seem to indicate that the fundus portion of the stomach is essential to the development of its anti-pernicious factor.

### Pathological Anatomy.

The relation between the microscopic findings and the prognosis will be touched upon only briefly and limited to the discharged Gävle patients. 26 cases (62 %) were without lymphatic gland metastases, 46 % of whom are alive after 3 years and 39 % after 5. 16 cases (38 %) had lymphatic gland metastases, 19 % of whom are alive after 3 years and 12 % after 5. WALTERS has 45 % of his cases without outer metastases alive after 5 years, as opposed to 17 % of those with metastases. Probably the author's proportion between the 2 groups is not reliable. In 1944 out of a large amount of material ST. JOHN had only 8 % without metastases, half of whom lived 5 years. Incision



margins without cancer were found in 37 (86 %), 12 of whom (32 %) lived 3 years and 9 (24 %) 5 years. Cancer in the lesser omentum but not in the incision margins was found in 4, all of whom died within 3 years, and cancer in the incision margins in 2, who died after 3 and 7 years. In 1 case of primary death cancer was found in the duodenal incision margin, and in 1936 CASTLEMAN pointed out that when there is a tumor near the pylorus, at least 3 cm. of the duodenum should be removed.

In 12 who survived the operation there was a cancer degenerated ulcer. 1 also had an unclear jejunal metastasis. 7 lived 3 years; 5, 5 years (41 %). 1 died of another disease after 1 year (post-mortem revealed no cancer). ALLEN gives 40 % with 5 year cure.

In 14 cases scirrhus was indicated. Only 3 of these survived 3 years and 2, 5 years (14 %). 1 died of cancer after 7 years and 1 is still alive after 7 years. Scirrhus is generally considered to have the worst prognosis.

In 16 cases different types of ulcerating cancers were found. In 1 number of typical tubercles were found within the cancerous masses and in another tuberculosis but not cancer in the lymphatic glands. 5 were cured in 3 years, and 4 in 5 years (25 %), but 2 of the latter died 6 and 7 years after the operation, according to the death certificates of cancer.

The last 3 cases consist of 2 with more regularly growing adenocarcinomas, who survived 9 years, and 1 with an unusual type of malignant, superficially growing adenopapilloma who died within 1 year. Otherwise superficial enlargement usually indicates a good prognosis (STOUT: 50 % 5 year cure).

As has been said above, several cases of partial resection were found after a number of years to have a recurrence in the remaining part of the stomach (roentgen or operation). The number cannot be determined because the majority did not report for examination. In the Gävle material it is these cases that motivated total gastrectomy even where partial resection might have been done. 3 died of cancer after 6—7 years. Naturally it is impossible to determine whether there was recurrence or new cancer in a susceptible organ.

### Conclusions.

I. The indications for total gastrectomy can be extended, because the primary mortality has sunk considerably during the past

years, but the final result is not yet better than in partial resection. The operation is undertaken first and foremost when there are corpus tumors located high up, scirrhus, and advanced canal tumors which have begun to grow over on the surrounding areas. Smaller canal tumors and cases with stronger contra-indications in general should doubtless be reserved for partial resection, while total gastrectomy should be done to a greater extent in less advanced cases than has hitherto been usual, in order to avoid later recurrences. Extended resection involving the surrounding organs and including paraorta metastases must be regarded as a deliberately palliative operation. "It seems logical that this operation (total gastrectomy) should be reserved for smaller rather than larger lesions, for with far-advanced cases the operative mortality is almost prohibitive and the number surviving 5 years is too small" (ACKERMAN and REGATO).

II. To improve the primary results and counteract postoperative complications and difficulty, regard should be paid to the following:

1. Preoperative blood and fluid balance. No confinement to bed before the operation. General condition. Emptying and rinsing of the stomach, possibly repeated several times. Chemoprophylaxis (as in intestinal tumors: "Sulfadigesin", "Sulftalyl" etc.).

2. Suitable anesthesia and effective supervision thereof.

3. Operation technique: immediate estimation of the possibilities of mobilizing the esophagus, sufficiently large resection in the surroundings, careful mobilization, shortest and least possible opening of the lumen, sufficiently long jejunal loop, careful covering of the anastomosis. Possibly continuous suction, entero-anastomosis, jejunal fistula.

4. Blood transfusion and intravenous administration of fluids postoperatively or during operation. Continuous checking on fluids. Liquids by mouth from beginning. Possibly chemoprophylaxis and thrombosis prophylaxis. Early rising.

5. Frequent checking during the first months of blood and general condition. Diet high in proteins, fats, vitamins, and calories and low in carbohydrates. Small, frequent meals, plus iron and often hydrochloric acid. Risk of acute inanition and dehydration.

6. Control of blood during the following years because of danger of pernicious anemia. Liver and iron therapy. New abdominal

difficulty may be due to narrowing resulting from scar tissue (which may require repeated dilatations), cancer recurrence, or intestinal disturbances following upon the gastrectomy.

### Summary.

Examination of 172 patients operated on in Gävle between 1929 and 1940 for cancer of the stomach, with special attention to 13 total gastrectomies. Primary mortality: resection: 23 %, total gastrectomy: 54 %. 5 year cure in 20 %—25 % of the former, 7 % of the latter. Of those discharged in the first group, 30 %—33 % alive after 5 years and 19 %—20 % after 10 years: in the second group, 16 % after 5 years, none after 10. Postoperative examination of the survivors shows little or no difficulty in the partially resected, but more in a number of these subjected total gastrectomy. The danger of recurrence in the remaining part of the stomach of the resected patients is worthy of note.

Examination of 24 total gastrectomies done in Boden in recent years. Out of 20 operated on in the same manner for stomach tumors, 2 died primarily. Many have died secondarily, but the survivors without metastases show remarkably little difficulty.

Description of technique of operation in the 2 series. Comparison with results and technique touched on in the literature.

It should be possible to extend the indications for total gastrectomy and apply them to cases more favourable in the early stages.

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## Peritoneal Irrigation in Uremia.

Report of Three Cases.

By

BJARNE FRETHEIM and OTTO SELVAAG.

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Since KOLFF and FINE, FRANK and SELIGMAN advocated peritoneal dialysis as a practical method of removal of waste products and toxic substances from an uremic organism, there have been several reports of cases treated by peritoneal irrigation (1, 2, 4, 5, 6, 7, 8, 9, 10). Different varieties of the principle have been used, and the composition of the lavage fluid has varied. The effect has been good in the majority of cases. The treatment has been used in uremias with varying etiology, such as anurias resulting from trauma (mechanical or thermal), incompatible transfusions, toxemia of pregnancy, poisoning with heavy metals, sulfonamide toxicity, and nephritis.

At Drammen Hospital three etiologically different cases of uremia have been treated by this method, only that we have varied the technic a little. The effect has been convincing in all of these cases.

*Case 1.* A 22-year-old woman had taken 2 gm. of corrosive sublimate per os on May 26th, 1947. In spite of early and adequate treatment the typical picture of corrosive sublimate poisoning developed with a complete anuria after thirty hours.

Saline, bicarbonate, plasma, and blood were given as an attempt to prevent the development of uremia by trying to keep the blood chemistry at normal levels. But in spite of this a perilous uremia developed after the anuria having persisted for eight days and a half. *Peritoneal irrigation* after the method of FINE, FRANK and SELIGMAN was instituted, therefore. The inlet was made in the right iliac region and the outlet in the left iliac region, using a mushroom catheter as an inlet tube, and the outlet being provided by a stainless steel

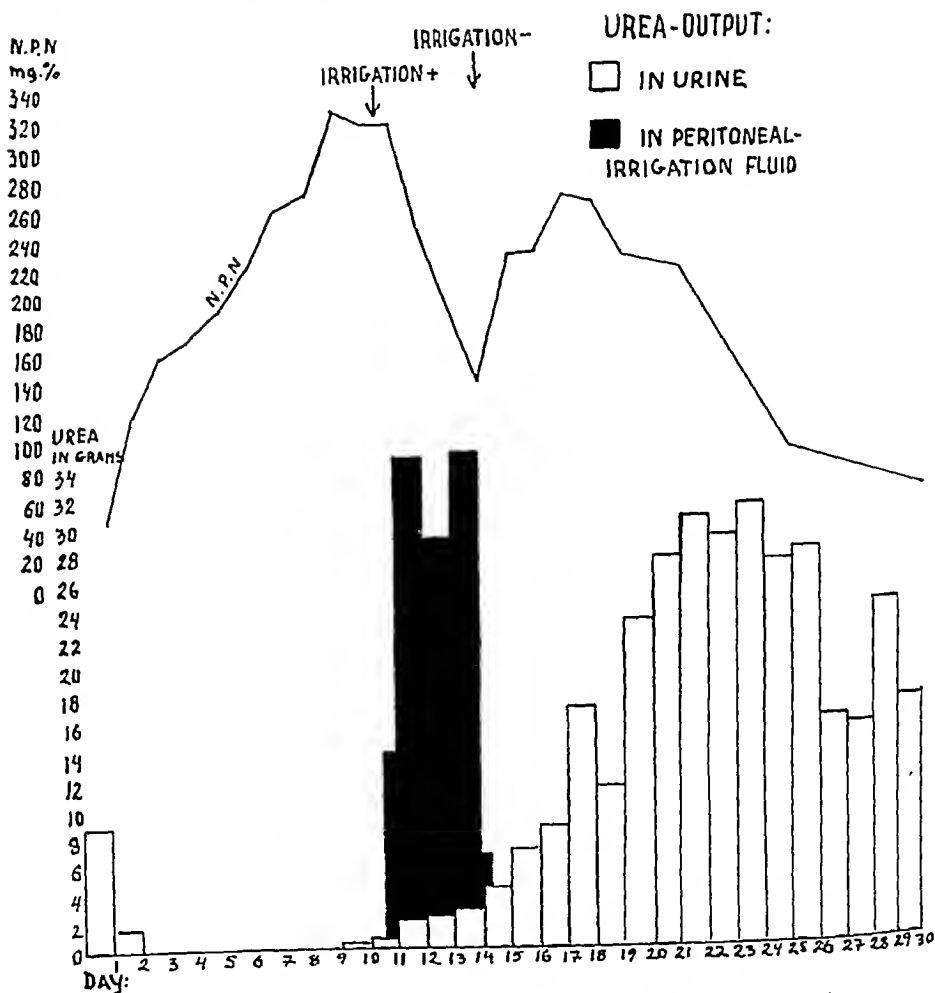


Fig. 1. Non-protein nitrogen and urea-excretion. (Case 1.)

sump drain reaching into the fossa Douglasi. The fluid for irrigation was composed of normal saline solution to which 1 per cent glucose and penicillin (10,000 units per liter) were added. Continuous drip was used, 1,000 cc. per hour (24 liters per twenty-four hours). The drainage was made by emptying the peritoneal cavity as completely as possible every 15 minutes. The irrigation was continued for 84 hours. Then it had to be interrupted because symptoms of subileus developed and the danger of peritonitis became too overhanging. When the irrigation was discontinued the symptoms of ileus disappeared, and within twenty-four hours the temperature, which had been slightly increasing, became normal. The further course was uneventful. The wound had closed after one week, and thus far the treatment has not caused any trouble.

The clinical improvement after the treatment being instituted was very satisfactory. The general condition was markedly improved on the following day, and the vomiting ceased. The blurred sensorium

Table 1.

Showing the control of fluid, electrolytes and serum-proteins (case 1).

Day after intoxication	Diuresis ml.	Irrigation fluid ml.	Urea-output (Grams)		N. P. N. mg % (blood)	Alkali reserve (mil/eq/l.)	Serum-Cl (mil/eq/l.)	Serum-Ca mg %	Serum-P mg %	Total base (mil/eq/l.)	Serum proteins g %	Hemoglobin %
			Urine	Irriga- tion fluid.								
1	1,900											
2	500				45	19.1	77.1					94
3	10				115	32.2	100.0					
4	5				160	24.8	91.4					
5	10				170	24.0	91.4					
6	1				190	22.6	87.1				4.65	
7	10				225	26.1	83.1				5.40	
8	38				260	20.9	82.6				5.87	
9	42		0.06		270	21.3	89.1				6.48	85
10	80		0.15		330	21.3					5.75	
11	298	7,850	0.80	13.2	320	19.6	82.2				5.40	
12	570	16,150	2.20	32.3	320	19.1	81.4				5.75	
13	590	14,125	2.60	26.4	240	22.6					5.38	94
14	710	16,900	2.80	32.1								
15	965	900	4.70	1.4	140		90.6				5.75	
16	1,335		7.00		230	19.6	101.2	7.6	9.3	152.2	5.40	70
17	2,035		8.60		230	16.1	100.0				6.1	
18	2,865		17.00		270	16.5	99.4				5.75	
19	3,490		11.20		265	16.5	88.0				5.75	68
20	4,775		23.40		230	23.0	97.0				6.10	
21	5,105		27.60									
22	5,200		30.40		220	24.4	100.0	7.9	6.0		6.10	
23	5,235		28.80		190	23.0	100.0					71
24	4,250		31.10									
25	3,585		27.30									
26	3,550		28.00		85		99.4				6.80	93
27	2,400		15.80									
28	2,430		15.40									
29	2,680		24.10									
30	1,880		17.30									
31	2,230				60	23.0	97.4					90

cleared up rapidly. The appetite came back after 2—3 days. The diarrhea ceased immediately, and the benzidine reaction in the feces became negative, having previously been constantly positive.

Prior to the treatment mild edemas of the nephritic type were noticed. These disappeared rapidly and were replaced by static edemas which appeared on the third day of irrigation, but then successively disappeared. The blood pressure rose to 165/95, but it rapidly came back to normal (125/75).

A scarce flow of urine (maximum 80 cc. per twenty-four hours) had begun prior to the irrigation, and on the day of the operation it even mounted to 300 cc. per twenty-four hours. It then increased steadily to more than 5,000 cc. per twenty-four hours. Few days after the irrigation had been instituted the urine presented formed sedi-

ments with few cylinders and a microscopical hematuria. There was a moderate proteinuria (0.075 per cent) which decreased rapidly, but a slight proteinuria and isostenuria persisted and were present at the time of the discharge, one month after the intoxication.

On a control examination one month later the edemas had disappeared and the renal function was normal. Roentgen examination of esophagus, stomach, and duodenum revealed normal conditions.

Fig. 1 shows that during the eighty-four hours of irrigation 105.5 gm. of urea, *i. e.*, an average of 30 gm. per twenty-four hours, was excreted in the drainage fluid, which is the same amount normally excreted in the urine. The largest amount excreted was 32.3 gm. per twenty-four hours. During the same period a total of only 8.5 gm. was excreted in the urine, and the vomit contained 0.6 gm. of urea. At the same time the non-protein nitrogen concentration sank from 330 mg. to 140 mg. per 100 cc. In spite of the steady increase of the diuresis the renal function when the irrigation was stopped was not sufficient enough to prevent an increase of the nonprotein nitrogen which thus increased somewhat for the following three days. Not until the fourth postlavage day did the non-protein nitrogen show a spontaneous decrease, and during the course of the abundant diureses the following days the nonprotein nitrogen level successively fell, so that it prior to the discharge was 60 mg. per 100 cc. Hemoglobin, serum proteins, chlorides, and the alkali reserve successively came up to normal (Table 1).

*Case 2.* The patient is a 55-year-old woman with marked adipositas and arterial hypertension. On the admission on June 27th, 1947, she suffered a bilateral pneumonia which had been treated with sulfathiazole. She was very exhausted, partly from the pneumonia, partly from uremia being caused by anuria. It was a hopeless case, but as an ultimum refugium *peritoneal irrigation* after the method of FINE, FRANK and SELIGMAN was instituted thirty-six hours after the admission and after a preceding ureteral catheterization with washing out of the urinary passages. The same technic as in case 1 was used. The irrigation fluid was this time composed of 1.8 per cent saline solution with 2 per cent glucose added, and the rate of inflow was adjusted to 2 liters per hour.

The patient died twelve hours after the dialysis was instituted. But a considerable fall in the blood urea had already then taken place. The sulfathiazole concentration in the outflow fluid was 2.1 mg. per 100 cc., in the blood it was 5 mg. per 100 cc.

*Case 3.* The patient is a 51-year-old farmer who for the last six years has suffered a chronic nephritis, the last two years associated with uremia for which he four times has been hospitalized. The renal function has for the last two years been poor, with a urea clearance of 25—50 per cent, isostenuria, and increasing blood urea. In the autumn 1945 his blood urea was 100 mg. per 100 cc., in June 1946 it was 243 mg. per 100 cc., and in June 1947, 390 mg. per 100 cc. A marked anemia has been present (Hb. about 50 per cent).

On September 24th, 1947, he was admitted to hospital for the fifth



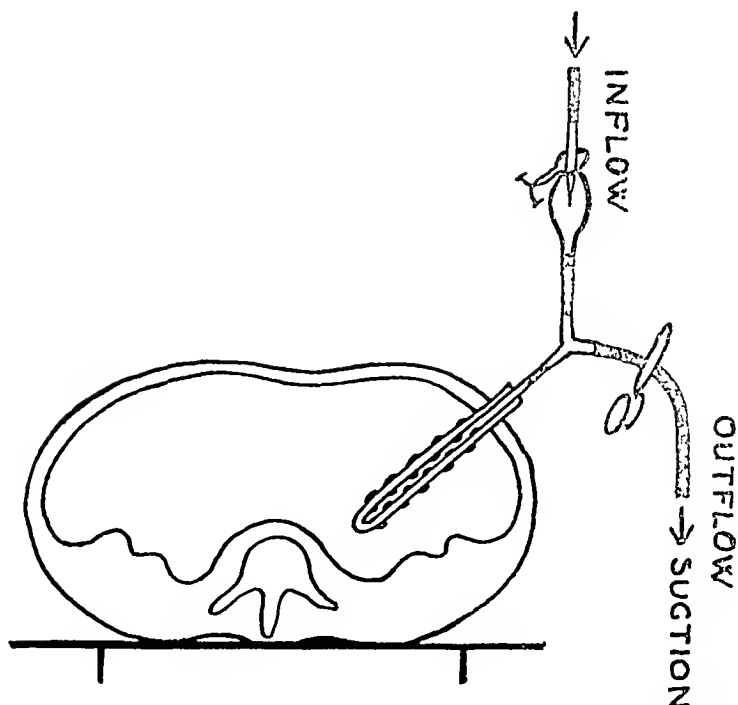


Fig. 2. Diagram of peritoneal irrigation system. (Case 3.)

time with uremic symptoms and a non-protein nitrogen concentration of 600 mg. per 100 cc. The hemoglobin content was 34 per cent and the alkali reserve 35 volume per cent. Fluid, bicarbonate and blood transfusion were administered. The non-protein nitrogen concentration showed no decrease (590 mg %). The alkali reserve became normal and the hemoglobin content rose to 57 per cent.

However, his uremic symptoms were increasing steadily. On October 3rd, 1947, he became comatous, and exitus did not seem to be far off.

Hence *peritoneal irrigation* was instituted, a modification of the method of REID and associates being used. One opening only was made to the peritoneal cavity and a sump drain was inserted to the fossa Douglasi (fig. 2). The drain was connected with a Y tube so that the lavage fluid could be run in through one of the branches and let out through the other. The amount of irrigation fluid was 36 liters per twenty-four hours. It was composed after the formula suggested by the Mayo Clinic (8): NaCl 0.6 per cent, KCl 0.02 per cent,  $\text{CaCl}_2$  0.01 per cent,  $\text{MgCl}_2$  0.01 per cent,  $\text{NaH}_2\text{PO}_4$  0.005 per cent,  $\text{NaHCO}_3$  0.3 per cent, and Dextrose 2 per cent. To this 10,000 units of penicillin per 1,000 cc. were added. As in the both previous cases, penicillin was also given intramuscularly as a prophylactic measure. The irrigation was made by running 400 cc. of the lavage fluid into the peritoneal cavity every 15 minutes. The fluid was run in within 5—6 minutes and left in the peritoneal cavity for 9—10 minutes and then aspirated.

Table 2.

*Urea excretion and blood chemical analysis (case 3).*

Day of irrigation	Urea-output (grams)		Urea-concentration (mg %)			Serum-proteins (g %)	Total base (milli/eq/l)	Serum-Calcium (mg %)	Serum-phosphor (mg %)	Serum-chlor (milli/eq/l)	Alkali reserve (milli/eq/l)	Xanthoprotein-values	Hemoglobin (%)
	Irrig. fl.	Urine	Irrig. fl.	Urine	Blood								
0		10.9		840	483	7.2	143.0	5.0	13.3	68.6	25.4	64	43
1 <sup>1</sup>	23.5	5.9	167	840	380	7.2	144.5	4.75	11.6	77.1	31.7	62	
2	56.7	3.0	160	480	222	6.8	161.8	5.0	9.0	93.0	32.6	52	
3	40.2	3.6	120	300	157	6.5	162.4	5.4	9.0	97.6	30.8	50	57
4	21.8	1.8	65	300	133	6.1		6.2	7.3		29.9		
5	26.2	3.0	77	252	162		152.0			99.6			
6	26.7	2.0	81	306	140	5.75	153.1	6.0	7.3	99.8	27.7	33	
7	15.7	1.5	62	250	112			6.4	10.5				
8	0.2	3.6	20	760									
9		4.2		1,045									
10		5.1		1,020	147	6.4	156.5	6.3	12.3	102.2	29.9	76	
12		11.9		702									51
14		7.5		834	323	6.1		5.8	11.0	97.1	19.6		64
17		9.6		876	410	6.1	147.2	5.5	10.5	100.3	20.9	62	74
24		11.7		790	390								

<sup>1</sup> 12 Hours.

The irrigation was continued for more than 7 days (175 hours). On the fifth day there was some meteorism which promptly disappeared by prostigmine. Otherwise there were no complications till on the sixth day when there came a rise of temperature and signs of peritoneal irritation. Peritonitis was supposed to be present, so sulfadiazine was given intraperitoneally. As the symptoms were still present on the following day, irrigation was discontinued at the same time as streptomycin therapy was instituted. During the following two days the temperature became normal. The symptoms of peritonitis disappeared and the wound closed within the following twelve days. Microbes could not be demonstrated in the outflow fluid, and the wound secretion contained white staphylococci only.

During the treatment a dramatical improvement of the patient's general condition took place. Even after thirty-six hours the patient was awake, answered questions and was apparently mentally alert, and asked for food. The urinary odor had disappeared. The tongue was less coated, and the muscular twitchings had almost ceased. The improvement continued so that he on the third day appeared quite normal. He had a complete amnesia to the entire hospitalization till the second day of irrigation. On the fifth day there were slight edemas of the ankles, but otherwise no edemas.

Clinical improvement paralleled that of clinical chemistry (Table 2, fig. 3).

The blood urea went down from 480 mg. per 100 cc. to 133 mg. per 100 cc. within 3 days and remained at this level till the third post-

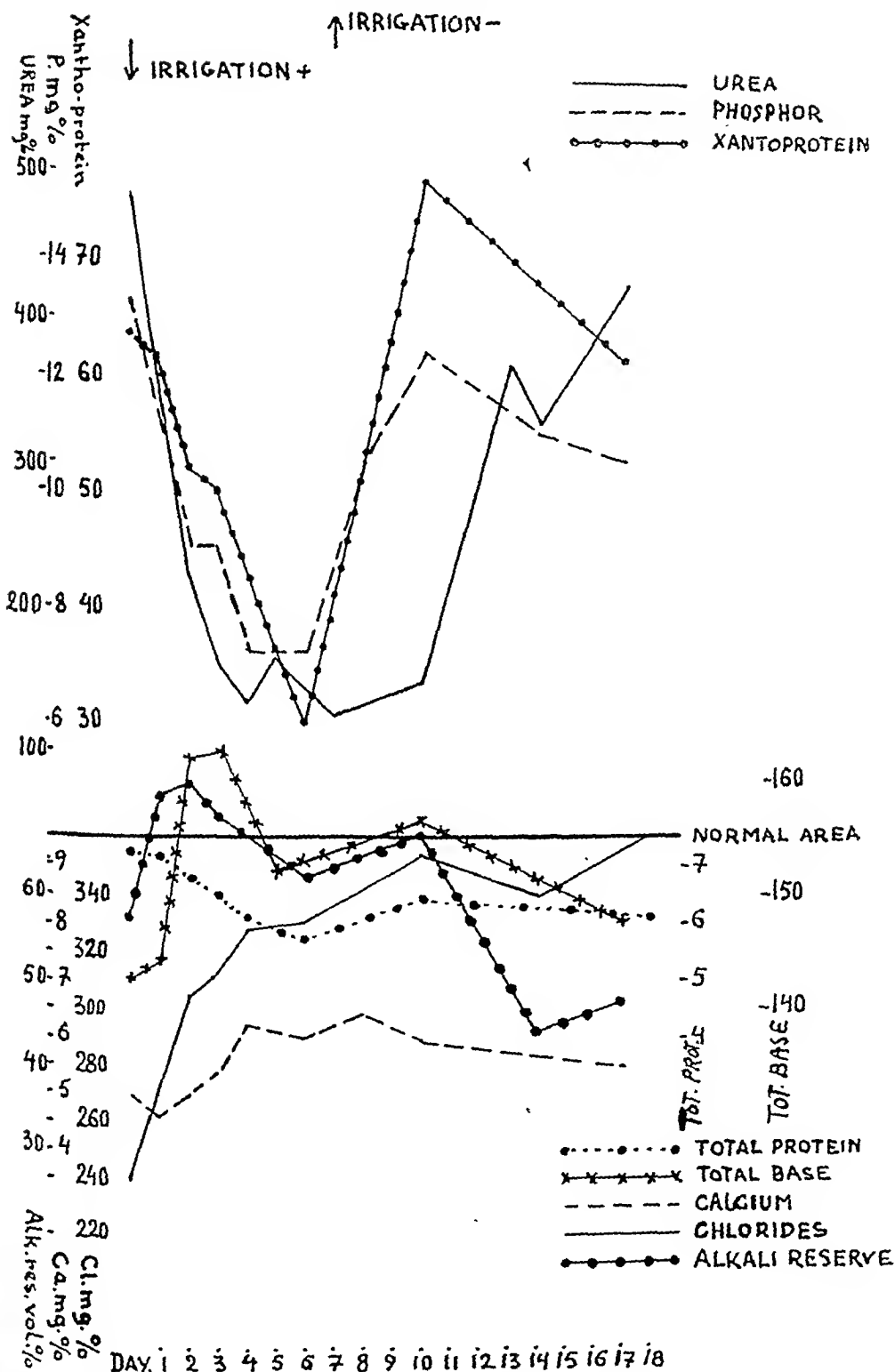


Fig. 3. Blood chemical analysis. (Case 3.)

Urea 59.  
(9 mm)

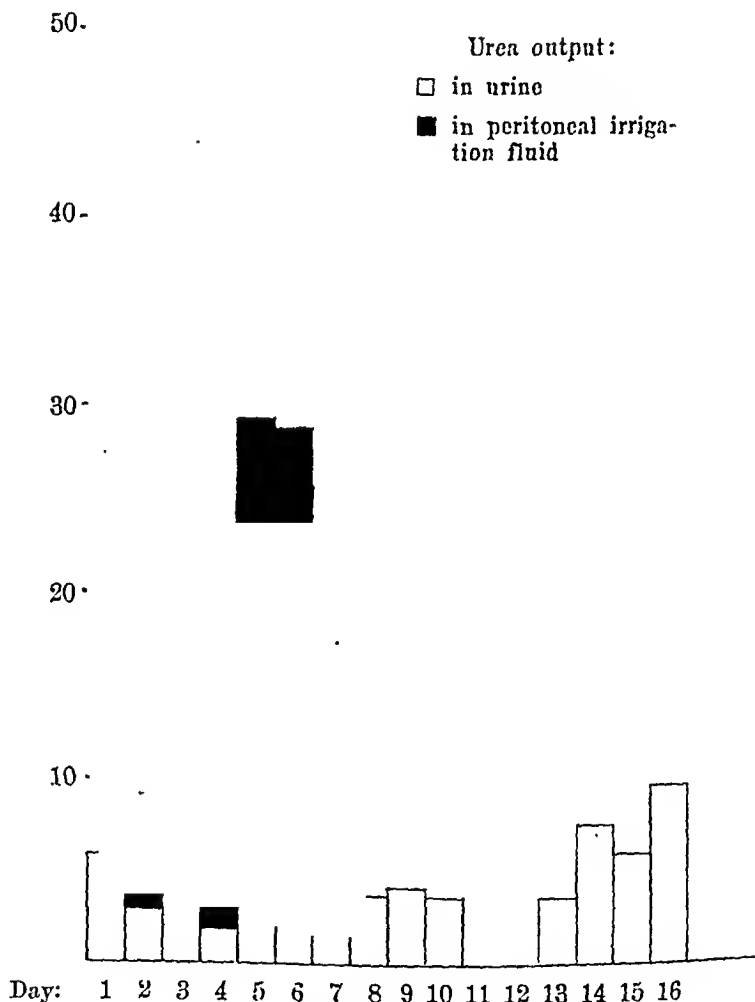


Fig. 4. Urea excretion in case 3.

lavage day. Then it rose rapidly. The xanthoprotein level showed a similar fall (from 64 to 33), but started to rise as soon as the dialysis was stopped. Phosphorus showed prior to the dialysis a marked increase (13.3 mg %), and here the lowest figures (7.3 mg %) were noted after three days of irrigation. Similarly to the xanthoprotein it rose rapidly as soon as the dialysis was discontinued. The other chemical findings in the blood had the same tendency of improvement during the treatment. Calcium rose from 5 mg. per 100 cc. to a little more than 6 mg. per 100 cc. where it remained during the irrigation period and then slowly decreased. Contemporaneously with the rise of the calcium content the muscular twitchings disappeared, only to reappear as soon as the calcium level fell again. (During the irrigation an addi-

tional 10 cc. of a 10 per cent  $\text{CaCl}_2$  solution was given intravenously two times daily.)

The chlorides rose from 240 mg. per 100 cc., rapidly approaching the normal level and then remained almost normal. The alkali reserve and the total base rose to moderate hypernormal figures which persisted during the irrigation, but then fell to subnormal values as soon as the irrigation was stopped.

The serum proteins make an exception, showing an even decrease from normal values to 5.75 gm. per 100 cc. on the fifth day. From this day plasma was given intravenously in amounts corresponding to 115 to 150 gm. pure protein per day. In addition to this the patient got two blood transfusions and a high protein diet. This made the serum protein rise to 6.45 gm. per 100 cc., and the hemoglobin level rose from 43 to 51 per cent, and after three additional transfusions the hemoglobin level was 71 per cent.

After the irrigation being discontinued, a rapid clinical aggravation set in parallelly with the aggravation in blood chemistry, and clinical uremia developed within about a week, and after two more weeks the patient died of his uremia.

*Autopsy* showed that the wound had healed completely and was peritonized. The peritoneum was smooth and glossy without any signs of congestion or fibrinous deposits. A small, veil-like adhesion was found between the appendix and the cecum, and two similar small adhesions behind the bladder to the left. These adhesions had apparently developed recently. Otherwise there were no signs of peritonitis. The kidneys were small and had the appearance corresponding to chronic nephritis. Their total weight was 325 gm.

Fig. 4 shows that large amounts of urea were removed from the body by the lavage fluid. During seven days and nights a total of 211 gm. of urea was eliminated, most of it during the three first days, the maximal excretion being 56 gm. per twenty-four hours. Later on the excretion was about 20—30 gm. per twenty-four hours. A total of 24 gm., i. e., 10 per cent of the total urea excretion, appeared in the urine.

### Comment.

Three cases of uremia have been treated by peritoneal irrigation (dialysis). Two of the cases were due to anuria following intoxication (corrosive sublimate and sulfathiazole, respectively), and one was a result of a chronic nephritis.

In all these three cases the treatment has had a definite effect upon the uremia. In the first case the treatment apparently was life-saving. However, a sparse flow of urine had started before dialysis was instituted (fig. 1), the diuresis the day before the treatment began being 80 cc. But the renal function was still markedly impaired, and not until eight days later the diuresis

was large enough to cause a decrease of the urea content in the blood. The perilous uremia which was present when the treatment started would without treatment undoubtedly have ended fatally before the renal function had become sufficient. Thus, the dialysis sustained the patient's life till the kidneys were restituted and able to check the intoxication. This is a typical example of a reversible renal lesion with uremia, where peritoneal irrigation will have to be considered.

The second case ended fatally, but the outflow fluid contained sulfathiazole in a concentration of 2.1 mg. per 100 cc. This shows that the substance responsible for the anuria (in this case the sulfathiazole) can be removed from the body by peritoneal irrigation if it only is fairly dialyzable. In a concentration like that in this case, 25—50 liters of lavage fluid will remove 0.5—1 gm. of sulfathiazole from the body per twenty-four hours.

The third case illustrates how not only the easily diffusible urea, but also other toxic products in uremia can be removed by peritoneal dialysis. Fig. 3 shows how the electrolyte values approach the normal level during the treatment. There are only two exceptions:

1. Calcium is apparently not provided in sufficient quantities by the irrigation fluid here used. Additional quantities had to be supplied by intravenous injection.

2. The serum proteins show a steady decrease caused by a considerable loss of protein via the irrigation fluid. The outflow fluid contained from 0.43 to 0.88 gm. of protein per 100 cc. Thus the loss with 36 liters of lavage fluid was 150—300 gm. pure protein per twenty-four hours. If the loss shall be replaced a high protein diet will not suffice, but large amounts must be provided parenterally. Checking the hypoproteinemia does not only serve to prevent edemas, but it also favours the dialysis and minimizes the tendency to subileus which alone might reduce the dialytic effect (3).

The technic of the performance of peritoneal irrigation is simple. The use of one opening only, the filling and emptying done by a Y tube, seems to be as efficient as a separate inlet and outlet as long as the dialysis is applied to the lower part of the abdomen. The use of a stainless steel outlet tube has proved very satisfactory, and the drain has in no instances been plugged. Autopsy in the third case revealed that there was astonishing little affection of the peritoneum, and there was nothing con-

## UREA-CONCENTRATION IN PERITONEAL IRRIG. FLUID, URINE AND BLOOD.

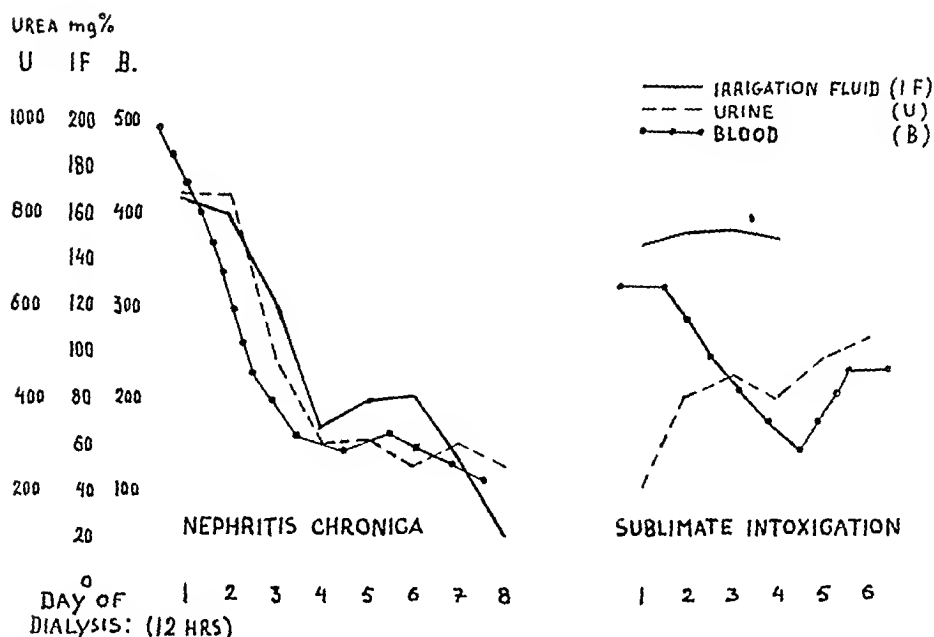


Fig. 5. Urea concentration in peritoneal irrigation fluid, urine and blood. (Case 1 and 3.)

traindicating a repeated irrigation through the same, or a new opening. Heparin was not added to the lavage fluid in any of the three cases. The removal of the fluid every 15 minutes instead of a continuous drainage seems to promote the dialysis and prevent obstruction of the drain.

A single opening minimizes the leakage, but 10 per cent of the fluid is not recollected, parts of it leaking out, parts being resorbed.

In the first case the irrigation had to be discontinued after a little more than three days on account of the development of a subileus. But during the whole course of the treatment the efficiency was constant in spite of a fall in the urea content of the blood (fig. 5 sublimite intox.). In the third case (fig. 5 nephritis chron.) the efficiency of the dialysis is seen to depend on the concentration of urea in the blood, as both figures fall parallelly. We have no explanation to why the first case differs from that but it might be due to the great difference in the composition of the lavage fluids.

The effectivity of the dialysis will otherwise depend of the size of the dialytic membrane. It will decrease if the dialytic area decreases, *e. g.*, as a result of adhesions, or if the dialytic ability

is decreased, *e. g.*, as a result of fibrinous deposits. However, no signs of this were found on the autopsy.

The treatment requires extensive laboratory work, but using the aforementioned lavage fluid will simplify the control of the electrolytes.

### Conclusion.

1. Peritoneal irrigation is an effective method of treatment of uremia, although it may cause infection and subileus.

2. The use of one opening only for running the lavage fluid in and out seems in the lower part of abdomen to be as effective as the use of two separate openings.

3. Fractional emptying seems to prevent the drain from being plugged.

4. By use of the technic described the method seems to be most effective and to cause least discomfort to the patient during the first 3—4 days.

5. The autopsy performed in one case did not reveal any peritoneal damage which might reduce the effectivity of the dialysis. Nor was there anything to contraindicate a repeated irrigation.

6. Additional administration of large amounts of protein (200—300 gm. per twenty-four hours) is necessary, in some instances also calcium and blood transfusions.

### Summary.

2 cases of anuria after intoxications (sublimate resp. sulfathiazole) and 1 case of chronic nephritis with uremic coma were treated with peritoneal irrigation. In the case of sublimate intoxication the treatment was started after  $8\frac{1}{2}$  days of anuria and continued for  $3\frac{1}{2}$  days.  $105\frac{1}{2}$  grammes of urea were removed and the N. P. N. dropped from 330 mg % to 140 mg %. The diuresis started again, and the patient obtained a complete restitution. The patient suffering from sulfathiazole-anuria was moribund and the case ended fatally 12 hours after the treatment was started. Sulfathiazole was removed from the organism simultaneously with the urea. In the case of chronic-nephritis with uremia the peritoneal irrigation was continued for seven days. Urea in the irrigation fluid came up to a total of 211 grammes, causing a drop in the N. P. N. from 480 mg % to 133 mg %. All the electro-



lytes controlled showed a similar tendency toward normal values. The condition also clinically showed an astonishing improvement. After the treatment a rapid deterioration set in causing exitus within 3 weeks. Technical details are discussed.

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## Local Application of Penicillin to Superficial Infections.

By

FREDERIK THERKELSEN and AGNETE LUNDSTEEN.

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From other countries we receive numerous reports on the local application of penicillin to infections of the hand and superficial infections elsewhere. The results appear to be favourable. It is, however, difficult to form an idea of the effect of local penicillin, as it is so often combined with local sulfathiazole or universal penicillin.

As pointed out by FLOREY & FLOREY universal administration of penicillin is the method of choice in order to obtain the best possible effect, but it is often difficult to carry out for economical and practical reasons. Therefore it is interesting to ascertain, if possible, the capacity of penicillin applied locally.

Among the results reported from England those of FLOREY & WILLIAMS are extremely encouraging, as the penicillin-treated cases grew sterile within a week, whereas the infection in the control cases usually persisted until the wounds had healed. Moreover, the healing time was considerably reduced in the penicillin-treated group.

Danish authors have also reported beneficial results from the local application of penicillin (O. POULSEN—JUUL—C. JØRGENSEN: Danish Society of Surgeons Oct. 12, 1946). These investigations deal partly with the clinical effect and partly with the qualitative bacterial effect.

At the Surgical Out-patients' Department of the State Hospital the writers have been using penicillin locally for a period

of about 18 months. At the same time a series of controls was treated by other methods (see below).

*The object* of this study was to gain as definite as possible an idea of the local effect of penicillin. It must, however, be realized beforehand that this is very difficult, unless the effect proves to be miraculously favourable, as superficial infections appear in so many different forms. Therefore, it is difficult to collect a fair number within each group — and furthermore the severity of the infection depends on so many unregistrable factors (the extent of the infection when treatment is commenced, the tendency to necrosis in each individual case, the resistance of the patient etc.) which influence the statistical comparison of the results.

For this reason the writers have tried to carry out a quantitative assessment of the bacterial growth during the treatment in addition to the clinical and qualitative bacteriological estimation.

Correspondingly, a study has been made of the effect of the control substances in relation to each other, especially in order to find out the value of the current chloramine treatment.

*Technique:* During a period of 18 months alternate cases were taken for penicillin treatment — without further selection. Thus every other case belongs to the penicillin group and every other to the control group. During the course of the infection the treatment had to be altered in a few cases which then were left out of the material (see below: Table 5).

*The penicillin used* was partly of Danish (Leo) and partly of British make. The first three-fourths of the material were treated with Danish and the remainder with British penicillin. A comparison between these two groups revealed no difference, and it has therefore been considered warrantable to treat them as one group in the present report.

1) Compresses of penicillin solution (1,000 Oxford units per cc.). Dressing changed once daily.

2) Gauze packs soaked in penicillin paste (2,000 Oxford units per 1 g. of paste). The base of the paste corresponds to unguentum molle. Dressing changed once daily.

3) Control: Chloramine compresses,  $\frac{1}{2}$  per cent. Dressing changed once daily.

4) Control: Gauze packs soaked in unguentum molle. Dressing changed once daily.

Table 1.

*Survey of the Part of the Material Used for Clinical Estimation.*

	Total	Penicillin		Total	Chloramine	Control		Total
		sol.	paste			Sal. sol.	Ungu. molle	
Inflamed wounds .....	35	16	2	18	16	0	1	17
Paronychia, subepid. ....	7	1	4	5	2	0	0	2
» periungual .....	43	13	10	23	8	6	6	20
» subcutan. ....	33	7	5	12	14	4	3	21
» ossosum .....	2	0	1	1	0	0	1	1
» articul. ....	1	0	0	0	1	0	0	1
» tendinos. ....	1	0	0	0	1	0	0	1
Furunc. abscess .....	39	13	6	19	13	2	5	20
Carbuncle .....	8	4	1	5	2	1	0	3
	169	54	29	83	57	13	16	86

5) Control: Compresses of physiological salt solution. Dressing changed once daily.

Swabs were obtained from the wounds prior to treatment — in the cases of paronychias and abscesses, however, following operative treatment carried out according to the ordinary principles. During the treatment swabs were taken every other or every 3rd day.

The material comprises infected wounds, paronychias, furuncular abscesses and similar inflammatory conditions (a few mammary abscesses) and a few carbuncles.

*Table 1* sets out the cases included in the clinical estimation, *i. e.* all cases in which there is a definite statement in the case record as to the "cleaning time", *i. e.* the period elapsing from the commencement of treatment until the wound is clean and granulating. The following tables also state the "healing time", *i. e.* the period from the commencement of treatment until complete healing of the wound takes place. The "healing time" is not stated in all cases, as some of the patients stayed away after the wounds were clean.

In *Table 2* may be seen the effect of penicillin on the entire material. It will be seen that the penicillin-treated cases exhibited a tendency to a more rapid disappearance of pus. The sepsis was, however, eliminated most rapidly in the cases treated with saline solution, in all probability because these cases were

Table 2.

*Survey of the Effect of Penicillin on the Material as a Whole.*

	"Cleaning time"	Total	"Healing time"	Total
Penicillin, solution .....	8.1	54	16.8	31
" paste .....	7.8	29	10.4	23
Control: Chloramine .....	10.4	57	18.4	47
Saline sol. ....	6.2	13	12.9	7
Ungu. molle .....	9.2	16	13.8	11
		169		128

particularly mild, the severe ones having to change over to another form of treatment (see below).

A comparison of all the penicillin-treated cases with all the control cases still shows an outcome in favour of the penicillin treatment.

The presumed favourable result of the penicillin might, however, be due to a particularly powerful effect on one group of diseases and thus outweigh a far less marked effect on other groups, when the mean figure is worked out. In Table 3 the material has therefore been divided into three large, fairly uniform groups and the average "cleaning" and "healing times" calculated. The outcome of this calculation was, however, still in favour of the penicillin, except for the group of furuncular abscesses etc. which exhibited a briefer period of "cleaning" and healing when treated with ungu. molle and saline solution than with penicillin. The

Table 3.

*Effect on the Material Grouped According to Diseases.*

	Total num- ber	Infl. wounds				Paronychias				Fur. absce. — Carb.			
		"Cl. time"	No.	"H.- time"	No.	"Cl.- time"	No.	"H.- time"	No.	"Cl.- time"	No.	"H.- time"	No.
Pen. sol. ...	54	9.5	16	20.1	9	6.2	21	13.8	15	9.0	17	19.1	10
" paste..	28	8.0	2	12.0	2	6.5	19	7.8	15	9.1	7	15.0	5
Chloramine .	55	11.3	16	19.5	13	8.7	24	15.6	19	10.5	15	18.0	13
Ungu. molle.	15	19.0	1	26.0	1	9.6	9	9.0	4	5.2	5	11.4	5
Saline sol. ...	13	0	0	0	0	6.9	10	13.0	6	4.0	3	12.0	1
Total	165		35			83				47			

Table 4.

	Total No.	"Cleaning time"						"Healing time"					
		Strept. (perh. + staph.)	No.	Staph.	No.	Coli	No.	Strept. (perh. + staph.)	No.	Staph.	No.	Coli	No.
Penicillin-treated group	70	8.2	17	7.8	52	4	1	14.3	13	14.0	35	7	1
Control group .....	78	11.2	25	8.7	52	4	1	19.8	18	15.1	37	11	1
	148		42		104		2		31		72		2

significance of these figures is, however, reduced by the small number of cases in the two groups.

A detailed report of the bacteriological findings will be given below, but it is necessary here to find out whether the genus of bacteria is of essential significance and whether it might have caused a different distribution of the results.

A calculation of the result in all penicillin-treated cases and all control cases shows that penicillin had a better effect on streptococci as well as staphylococci (Table 4).

The "healing time" has not yet been dealt with in detail, but only included for the sake of completeness. The reason is that a comparison based on the "healing time" is probably of very little significance in a material of this size. The "healing time" must depend on an even larger number of unregistrable factors than the "cleaning time", as the depth and extent of the wounds as well as the nature of the granulations must be of the greatest significance in this respect.

A fact which has not been dealt with earlier is that some cases of the original material had to be ruled out and therefore are not included in the tables given above. It is a question of cases in which the treatment had to be altered during the course of the disease, either because of an alarming exacerbation of the symptoms (severe infiltrations, pain etc.) or because the state of the wound remained stationary for several days.

These cases are illustrated in Table 5.

It is evident from the table that the treatment had to be altered in 7 cases. All these cases occur within the control group and exclusively among the cases originally treated with ungu. molle and saline solution. This is the explanation of the surprisingly brief "cleaning times" apparent particularly in the group

Table 5.

*Cases in Which the Treatment had to be Altered.*

	Number	"Cleaning time"			
		Par. subepid.	Par. peri- ungual.	Par. subc.	Par. oss.
Penicillin, sol. ....	0	> 7 <sup>2</sup>	8 <sup>1</sup> 21 <sup>1</sup> 37 <sup>1</sup> 26 <sup>3</sup>	> 6 <sup>1</sup>	41 <sup>1</sup>
» paste ....	0				
Chloramine ....	0				
Ungu. molle ....	3				
Saline sol. ....	4				
Total	7	1	1	1	1

treated with saline solution in which a series of severe cases had to be left out beforehand. It has been emphasized by several authors that the application of penicillin quickly relieves the patients of pain in the wounds. This is not a striking feature of the writers' material, although it did occur in a few cases.

In addition, a total of 8 mammary abscesses etc. were successfully treated with aspiration and injection of a solution of penicillin without requiring incisions. The same effect was, however, obtained in 4 control cases submitted to injections of physiological salt solution instead of penicillin.

Let it be mentioned that the injection of penicillin was painless.

The clinical results may be summarized as follows:

1) Penicillin appears to have a better, *i. e.* a more rapid effect than the substances used in the control experiments. The present material does not, however, afford a statistical proof. This would require a far larger number of cases, in order to eliminate the variations in the extremely motley picture presented by the diseases investigated.

2) Treatment with chloramine compress, so common up to now, appears to be just as good — and possibly better — than a treatment without the use of bacteriostatics — particularly when regard is paid to the comparatively large number of cases in which the latter treatment had to be altered.

<sup>1</sup> Treatment altered to chloramine compress.

<sup>2</sup> » » » boiled water compress.

<sup>3</sup> » » » powdering with alfasol (trade name for a neutral powder of solu-sulfathiazole).

Before proceeding to a *detailed bacteriological* estimation of the material, it is necessary here to describe the technique and the nomenclature used.

*Technique:* Swabs were taken from the discharge from the wound immediately before the treatment and then every other — every 3rd or 4th day during treatment.

On the same day the swabs were partly plated on ordinary blood agar — partly cultivated in a liquid culture medium (serum bouillon).

The genus of the bacteria has been determined in the usual way by inspecting the appearance, colour and shape of the colonies on blood agar. In a few cases special investigations were made to obtain a more accurate determination of the genus.

*Nomenclature* used in the quantitative estimation of the bacterial growth:

Ample growth (amp.): Confluent growth on blood agar + growth in liquid culture medium.

Medium growth (med.): Growth on blood agar in individual colonies exceeding 100 + growth in liquid culture medium.

Sparse growth (sp.): Less than 100 colonies on blood agar + growth in liquid culture medium.

Very sparse gr. (v. sp.): No growth on blood agar + growth in liquid culture medium.

No growth (÷- gr.): No growth on blood agar ÷- growth in liquid culture medium.

The quantitative estimation of the bacterial growth has been the same in the case of all pathogenic bacteria. As pathogenic bacteria are grouped the ordinary pyogenic bacteria: *Staph. aureus* and *albus* as well as haemolytic and non-haemolytic streptococci. The growth of *B. coli* which are not penicillin-sensitive, and the growth of non-pathogenic bacteria is set out in a separate group.

*Table 6* presents the qualitative and quantitative estimation of the result of the cultivations from swabs taken before and after treatment including all the cases (137).

As mentioned above the material comprises diseases which from a diagnostic point of view are divisible into 3 main groups: (I) Inflamed wounds. (II) Various forms of paronychia. (III) Furuncular abscesses and carbuncles. In the comparisons made below regard is paid to the fact that the penicillin group and the control group contain approximately the same number of cases of the various diseases.

*Table 6* shows a distinct effect on the bacterial growth, quantitative as well as qualitative, as soon as the penicillin treatment



Table 6.

*Results of Cultivations from Swabs Taken from all the Cases.*

	Before treatment		1—8 days after commencement of treatment		Total number of swabs taken after commencement of treatment	
	Penicillin group	Contr. group	Penicillin group	Contr. group	Penicillin group	Contr. group
Number of cases....	69 <sup>1</sup>	68 <sup>1</sup>	69	68	69	68
Number of swabs....	69	68	136	117	201	206
Growth (amp.).....	41	42	24	67	31	93
of (med.).....	11	4	22	12	24	30
pyog. (sp.).....	6	15	26	28	43	45
bact. (v. sp.).....	14	13	33	29	51	53
Tr. of non-path. bact..	0	0	6	0	10	0
Gr. of <i>B. coli</i> .....	4	2	15	1	25	4
÷ gr. ....	2	4	31	9	47	32

is started. A sterile discharge from the wound, non-pathogenic bacteria or bacteria not penicillin-sensitive (*B. coli*) are more frequent findings in the patients treated with penicillin than in those not receiving penicillin.

When compared in the same manner each diagnostic main group gives practically the same results as the entire material. For lack of space a schematic representation has to be left out.

The cases treated with penicillin have not received an absolutely uniform treatment. Some have been treated with penicillin solution compresses (47) and others (22) with penicillin paste.

Among the control material 40 were treated with a solution of chloramine, 13 with compresses of physiologic salt solution and 15 cases with ungu. molle (the same base as that used in the penicillin paste).

Table 7 represents a comparison between the 40 cases treated with a solution of chloramine and the 47 cases treated with a solution of penicillin.

As appears from the table the results are identical with those found by a comparison between all the cases of the material.

A similar result was obtained by comparison between 22 cases treated with penicillin paste and 28 cases treated with either ungu. molle or physiologic salt solution (Table left out for lack of space).

<sup>1</sup> The total number of cases (137) included in the bacteriological examinations is somewhat smaller than that included in the clinical part out of regard to the bacteriological groups. This part only includes the cases from which swabs were taken regularly during the entire course of the treatment.

Table 7.

*Comparison Between the Cases Treated with Penicillin and Those Treated with Chloramine.*

	Before treatment		1—8 days after commencement of treatment		Total number of swabs taken after commencement of treatment	
	Penicill. group	Chloram. group	Penicill. group	Chloram. group	Penicill. group	Chloram. group
Number of cases ...	47	40	47	40	47	40
Number of swabs ...	47	40	83	49	127	103
Growth (amp.) .....	30	23	19	30	26	48
of (med.) .....	8	2	13	1	14	9
pyog. (sp.) .....	3	11	20	12	33	20
bact. (v. sp.) .....	11	10	18	18	26	36
Gr. of non-path. bact..	0	0	4	0	5	0
Gr. of <i>B. coli</i> .....	2	2	10	0	18	2
÷ gr. ....	2	2	15	2	26	16

Table 8 presents a comparison between all cases treated with a solution of chloramine (40) and all cases treated with non-bacteriostatic substances (ungu. molle or physiologic salt solution). (28.)

It is evident that the cases examined have not exhibited a more marked bacteriostatic effect from chloramine than from the non-bacteriostatics.

On the whole the application of penicillin in these cases has demonstrated a favourable effect of penicillin as far as bacterial growth is concerned. In the penicillin-treated group there has been a more marked arrest of the growth of pyogenic bacteria, more frequently a sterile discharge from the wound. In cases where the discharge has not been sterile, a striking number of cases has exhibited a change in the bacterial growth, *i. e.* bacteria resistant to penicillin (*B. coli*) or non-pathogenic bacteria.

When assessing the effect of the penicillin treatment — which appears to be distinct in the bacterial examinations reported above — one is faced with two questions:

1) Is the apparent bacteriostatic effect of penicillin perhaps due to the presence of small residual amounts of penicillin in the discharge from the wound, so that the growth of bacteria is arrested during the cultivation?

2) Is the effect of penicillin perhaps only an arrest of the bacterial growth in the discharge from the wound without real effect on the underlying tissues?

Table 8.

	Before treatment		1—8 days after commencement of treatment		Total number of swabs taken after commencement of treatment	
	Chlor. treatm.	Non-bacterio-static. treatm.	Chlor. treatm.	Non-bacterio-static. treatm.	Chlor. treatm.	Non-bacterio-static. treatm.
Number of cases ...	40	28	40	28	40	28
Number of swabs ...	40	28	49	68	103	103
Growth (amp.) .....	23	19	30	37	48	45
of (med.) .....	2	2	1	11	9	21
<i>pyog.</i> (sp.) .....	11	4	12	16	20	25
<i>bact.</i> (v. sp.) .....	10	3	18	11	36	17
Gr. of non-path. <i>bact.</i> ..	0	0	0	0	0	0
Gr. of <i>B. coli</i> .....	2	0	0	1	2	2
÷ gr. ....	2	2	2	7	16	16

The latter is not improbable on the face of it, in view of the fact that granulation tissue forms a barrier fairly impermeable to substances from without.

Re 1) It ought to be mentioned that the swabs were always taken at least 24 hours after the last changing of the penicillin compress or gauze pack, so that the presence of active penicillin appears extremely unlikely. In order to elucidate this question further a small series (15) of swabs from patients treated with penicillin paste has been submitted to double cultivations, *i. e.* on blood agar containing *penicillinase* as well as on ordinary blood agar. The content of *penicillinase* ought to eliminate the effect of any penicillin which might be present and exerting a bacterio-static influence.

The result of both forms of cultivations was, however, approximately the same. (The table has been left out for lack of space.) Accordingly, there is nothing to indicate the presence of penicillin in the discharge from the wound used in the cultivations reported.

Re 2) It is impossible to rule out definitely that the effect of penicillin is merely an arrest of the bacterial growth in the discharge proper. This possibility is, however, contradicted by the fact that in assessing the clinical effect on the material the writers found a favourable effect on the "cleaning" (and partly the healing) of the wounds, an effect which is probable, although not proved statistically.

It is to be presumed that the results of the local application of

penicillin reported above can be further improved, if the concentration of penicillin in paste etc. is increased — and when regard is paid to the results of later investigations concerning the significance of the base to the optimal effect of the penicillin (LUND).<sup>1</sup>

Another factor in favour of the local application of penicillin is that — unlike practically all other drugs used for the treatment of wounds with a disinfectant effect — penicillin has no irritating or damaging effect on the tissues.

### Summary.

The effect of local application of penicillin to a series of superficial infections (inflamed wounds, paronychias, furuncular abscesses and carbuncles etc.) has been studied.

The material comprises a total of 83 penicillin-treated cases and 86 control cases. The effect of the penicillin treatment is discussed, partly from a clinical point of view, partly on the basis of a qualitative and quantitative bacterial examination.

According to the investigations the clinical effect of penicillin appears to be a somewhat quicker "cleaning" than with the control substances (chloramine, ungu. molle and physiologic salt solution). A definite statistical proof, cannot, however, be advanced. As far as the arrest of bacterial growth is concerned penicillin reveals a more powerful effect than the control substances. The control substances employed in this material all appear to be of approximately equal effect.

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<sup>1</sup> Personal communication.

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## Radical Extirpation and Primary Closure of Deep Thoracic Fistulas.

By

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The treatment of deep thoracic fistulas and fistulous thoracic cavities, abscesses and empyemas has hitherto generally consisted of (1) thoracoplastic operations, (2) broad opening and packing, possible in conjunction with suture or cauterization of bronchial fistulas, (3) grafting of tissue, especially musculature or skin. In the case of large empyema cavities (4) thoracotomy with decortication is often the method preferred. Combination of these operations have frequently been used.

PERTHES proposed (1908) to dissect chronic partially epithelialised lung abscesses. LEBSCHÉ (1924) likewise partially dissected the wall free of the lung, but folded it together and thereby enclosed the bronchial fistulas in the bottom. In all the methods primary closure is not advised. All authors seem agreed on this until LANDOIS in the last edition of KIRSCHNER and NORDMANN's textbook (1941).

HEAD has suggested (1945) a method for primary closure after thoracoplastic operations for chronic empyema. He introduces a thin drain into the cavity, uses suction and rinse twice daily with a 1 % solution of a sulpha preparation. In most cases quick healing is hereby obtained. This method of operation does not preserve the function of the lung as the obliteration is obtained by extensive thoracoplastic operations.

## The Author's Method.

Here is described a method which aims at preserving the function of the lung and attaining quick results. The operation is a thoracotomy with complete removal of all pathological tissue and suture of bronchial fistulas.

The fistula must be in a quiet state with comparatively slight, preferably not putrid discharge. This is achieved by an ambulant treatment for at least a month. It demands at least two negative cultivations of tubercle bacilli. Only cases which have remained unchanged at least six months are operated upon.

Before the operation bronchoscopy and bronchography take place and the cavity filled with contrasting matter is X-rayed in several planes and with the patient in different positions. The extent of the cavity is marked on the skin. 1 % methylene blue is injected with light pressure.

Total anaesthesia is given with tracheal intubation and controlled or compensated respiration. A compound of nitrous oxide and oxygen combined with an intravenous anaesthetic (eitodan, nareodorm) is used. Explosive gases cannot be used as it is necessary to use electrocoagulation and there are generally bronchial fistulas which conduct the gases to the field of operation.

A spindle-shaped incision is made round the skin-fistula. The direction and length of the incision is determined by the extent of the cavity, but it mainly follows the direction of the ribs. The fistula is closed by a gauze tampon and is held by Marseux's forceps. The incision is directed through the musculature to the ribs and at the same time the fistula is followed here. The rib regenerates round the fistula are exposed with careful roughening without any lesion. A rib is also uncovered as far forward and backward as the thoracotomy necessitates, generally about 20 cm. and it is then cut together with the regenerates. The fistula is then followed into the thorax cavity. The lung is freed to the extent that observation requires. It is first dissected free from the inside wall of the thorax and most of the thickened parietal pleura over the cavity is removed. Generally this cannot be done without lesion of the wall. Pus is immediately removed by suction. During the intrathoracic operation long-handled instruments, one or two light carriers and suction apparatus are necessary. The dissection of the pathological tissue from the lung takes the form of decortication or cyst excision. The cleavage here is often quite

good. In the bottom several larger blood vessels are met with and they are ligated, and frequently larger bronchia, which are sutured, possibly after removal of mucous membrane in the extreme ends. Lastly all pathological tissue is removed and no blue-coloured parts are to be seen. There remains now an intrathoracic cavity whose extent is surprising in comparison with the tissue removed. The lung is at this stage soft and expansible, almost like a normal lung. Normally no impression of the extirpated cavity can be seen on the lung. But if a deeper wound is found on the lung, it is sutured. When the haemostasis is complete and the lung is airtight, the whole cavity is sprinkled with penicillin (200—300,000 units) and sulphathiazole (10—15 grams). The lung is expanded. The thorax wall is closed in layers. If the parietal pleura and the intercostal musculature cannot be closed sufficiently a few pericostal sutures are applied. All sutures are made of silk. No drain is inserted.

During the whole operation haemostasis must be complete. This occupies at least half the time. Electrocoagulation is unavoidable as ligature is impossible in the inside of the thoracic wall in fibrous tissue with hundreds of strongly bleeding small blood vessels. Haemostasis of the lung is obtained by compression of small blood vessels and ligature of larger blood vessels.

At the beginning of the operation 200,000 units of penicillin and 2 grams sulphathiazole are given intravenously. These preparations are continued intramuscularly and perorally respectively for 4—7 days. A dose for 24 hours is 200,000 units and 5 grams respectively.

Immediately after the operation and on each of the following days strong aspirations are made from the wound cavity with a syringe. After the aspirations 100,000 units penicillin dissolved in 10—20 ccm. water are injected. The exudate is examined each time with aerobe and anaerobe culture for bacteria and with a view to its haemoglobin content. The injections continue until there is no more exudate. X-ray control takes place daily in the first week, less frequently after that.

In order to ease postoperative pains intercostal block with a 2 % solution of benzocaine in propylenglycole (2—3 cc. in each intercostal space) is made at the end of the operation. This gives good analgesia for a couple of weeks. The injections may be made without anaesthesia. 1—1½ cg. morphine is used 2—3 times in 24 hours.

The patients get up after a week and are discharged after 2—3 weeks.

The main points of the operation are (1) the very careful haemostasis, (2) the complete removal of all pathological tissue, and (3) the durable closure of the bronchial fistulas. It is therefore a fairly long operation which generally requires  $1\frac{1}{2}$ —2 hours. Most important during postoperative treatment is (4) the frequent and vigorous aspiration, so that the cavity obliterates quickly, completely and without the formation of fibrous thickening of the tissues which can compromise the functioning of the lung. That the operation can be carried out in this form is due to (5) the strong dosing of penicillin and sulpha preparations. A preoperative resistance determination of the microbes is rational, but has hitherto only been performed in two cases with especially instructive results (case reports 2 and 5).

### Case Reports.

The earliest case operated will be described in detail with X-ray photographs (case report 1). Only a few of the peculiarities of the other cases will be mentioned, as they are otherwise fairly uniform.

*Case report 1.* Man 34 years (513/1946). Six months earlier lung abscess on the right side with total empyema, which was treated with rib resection and suction drainage. Pneumococcus type 2 was proved six months later. ROBERT's operation was performed on a rest cavity quite the size of a man's hand. Altogether 106 cm. of the 5th—9th ribs were removed. Meanwhile there still remained a cavity the size of a tangerine with constant symptoms of bronchial fistulas and secretion of 5—10 grams in 24 hours (figs. 1 and 2). Besides pneumococcus type 2 haemolytic streptococci were also proved in the pus. Vital capacity 2.3 litres.

*Operation* 16. 11. 1946 (HANSEN): Fistula and cavity walls extirpated. The bronchial fistulas are sutured. 200,000 units penicillin, 10 grams sulphathiazole. Primary suture. (Fig. 3.) The postoperative course is indicated in fig. 4.

An atelectasis of the whole of the left lung is treated on the third day with bronchoscopic aspiration. An exudate is aspirated: 1st day 240 ccm., 2nd day 75 ccm., 5th day 30 ccm., 11th day 15 ccm., 16th day 3 ccm., 17th day 1 ccm. The exudate was always without growth with aerobe and anaerobe culture. The haemoglobin percentage on the first day was 22 %, 2nd day and later under 10 %. Sulphathiazole was given for four days, penicillin for seven. For three days the temperature was between 38 and 38.4° C. The fever was apparently due partly to the atelectasis; it fell immediately after the bronchoscopy.





Fig. 1. Case report 1. Man 34 years. 18 month old lung abscess and empyema. RONCERS' operation without effect. Cavity partly filled with contrasting matter. Prone position. Secretion 5—10 grams. Expectorate 10 grams.



Fig. 2. Case report 1. Same as fig. 1 left side.

HANSEN: Deep Thoracic Fistulas.



Fig. 3. Case report 1. Four hours after thoracotomy with extirpation of the walls in the cavity and suture of the bronchial fistulas. The wound exudate not yet aspirated. Sitting position.



Fig. 5. Case report 1. A month after discharge. Fistula healed. Temperature normal. No expectorate. Cavity closed.

Completely normal temperature after a week. The expectorate, which before the operation amounted to 10 ccm. in 24 hours, fell to below 1 ccm. The wound healed primarily. The skin sutures were removed on the 12th day. The patient got up 10 days after the operation and was discharged four days later. A month after discharge

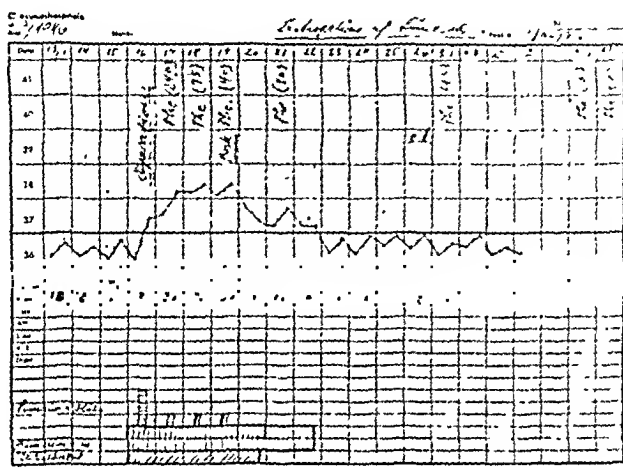


Fig. 4. Case report 1. Temperature chart. Operation and thoracocentesis (Tbe.) together with bronchoscopy (Brsk.) for atelectasis are given. The amount of secretion and under that the amount of expectorate is given in figures under the chart. Lastly doses of penicillin in the wound cavity, and intramuscularly as well as sulphathiazole perorally.

the lung field was roentgenologically clear. (Fig. 5.) Vital capacity 3.2 litres. The patient has since been completely fit. Observation period 16 months.

The next case which was operated upon developed slightly different, probably on account of the microbes' lack of sensibility towards the antibioticum and chemotherapeuticum used.

*Case report 2.* Man 36 years (73/1947). 10 months earlier lung abscess of the left side and total empyema. Now cavity 16 cm. deep with intermittent symptoms of bronchial fistula. Secretion 15 grams in 24 hours with staphylococcus aureus and alkaligenes faecalis. There were frequent instances of retention with high temperature which had necessitated admission to hospital three times. *Operation 27. 1. 1947 (HANSEN):* Fistula and cavity walls extirpated. As the lung does not become sufficiently expansible after decortication, the five ribs lying over the cavity are resected, altogether 73 cm. A ROBERT's flap of pleura parietalis is laid in the cavity, 200,000 units penicillin and 10 gram sulphathiazole. Primary suture. 1st day 300 ccm. is aspirated, 2nd day 210 ccm. By culture the same microbes as before the operation are detected and the same answer to resistance definition; no sensibility. As there moreover was a temperature of 39.5° C.

drainage was performed on the 4th day. The drain was connected with the central suction plant. The temperature fell promptly in a week, the secretion fell to 10 cm. in 24 hours. Three weeks after the operation the patient could be discharged with a fistula 5 cm. deep and with primarily healed wound. The fistula healed in a month. The patient has since been well. Observation period 14 months.

One patient was so much affected in spite of relatively small cavity that amyloidosis was feared.

*Case report 3.* Man 30 years (117/1947). A year before, after a laparotomy, a lung abscess of the right side and total empyema developed. For nine months unchanged fistula 14 cm. deep from posterior axillary line to the columna with secretion 20 grams in 24 hours (*staphylococcus aureus* and *streptococcus haemolyticus*). Constant symptoms of bronchial fistula. Intermittent albuminuria. Thin, tired. Loss of weight of 11 kg. since acute illness never made up. *Operation* 29. 3. 1947 (HANSEN): In the bottom of the fistula with the passage to the mediastinal surface of the lung an abscess cavity as big as a walnut with several bronchial fistulas, which are sutured. Primary suture. Aspiration of wound exudate three times. Rise of temperature to 39.4° C the day after the operation, after this lytic fall of temperature to normal in six days. Wound healed primarily. The patient has since been well. No albuminuria. Weight increased by 6.5 kg. Observation period 12 months.

In another case the general condition was similarly affected by the thoracic fistula. There was a constant and considerable blood sedimentation rate.

*Case report 4.* Woman 37 years (141/1947). 9 months previously lung abscess of right side and limited empyema. Constant bronchial fistula of 16 cm. Secretion 5—10 grams in 24 hours. Blood sedimentation rate never lower than 64 mm an hour. *Operation* 28. 4. 1947 (HANSEN): Paravertebrally an abscess cavity as large as a pigeon egg with thin epithelialised walls with two larger bronchial fistulas. After extirpation the lung wound may be sutured in two layers. Aspiration only once after the operation. The patient has since been well. Observation period 11 months.

In the last case to be reported the pus was putrid and all pathological tissue was not successfully removed. This did not, however, prevent progress free of complications. Sensibility of microbes to penicillin and sulphathiazole was here proved.

*Case report 5.* Man 47 years (152/1947) 11 months previously lung abscess of right side and total empyema. Since when constant putrid secretion fistula more than 20 cm. deep in regio infrascapularis, stretching upward and forward. Intermittent symptoms of bronchial fistula. Non-haemolytic streptococcus with sensibility to penicillin

proved. *Operation* 13. 5. 1947 (HANSEN): pleura 5 cm. thick. Fistula reaches to front part of 2nd rib. Hardly possible to remove all pathological tissue from inside of thorax wall in upper portion of cavity, but after decortication lung becomes completely soft. No demonstrable bronchial fistula. 300,000 units penicillin and 15 grams sulphathiazole. Smooth progress afterwards. Maximum temperature 38.2° (2nd day), normal from 4th day. No aspiration from wound cavity. Strong decrease in great opaqueness of upper lateral part of the field of the lung caused by thickening of pleura. The patient has since been well. Observation period 10 months.

### Commentary.

The operation resulted in all cases in the cure of the patients' chronic deep thorax fistulas, which had lasted from 6—12 months. In one case primary healing was not achieved, as drainage had to take place on account of persistent infection. The microbes were here resistant to penicillin and sulphathiazole (case report 2). The patient could, however, be discharged 3 weeks after the operation and was healed a month afterwards. The other patients were all healed primarily. This is also true in a case (case report 5) where the putridness of the pus had not been removed successfully before the operation and where during the operation it was not possible to remove all pathological tissue. The sensibility of the microbes to penicillin and sulphathiazole has apparently contributed here to the good result, just as it achieved good expansion of the lung during the operation.

The operation is less severe than even the most selective thoracoplasty would be in the given cases. No skeleton deformity results. With the removal of all infectious tissue the best possible lung function is achieved. The primary and complete closure without tamponade or drain gives penicillin and sulphathiazole a chance to work constantly on the field of operation and it moreover gives the shortest and easiest postoperative treatment.

### Summary.

A method for the operation of deep thoracic fistula with chronic empyema or abscess of the lung is described. Regular large thoracotomy is made and all pathological tissue removed. The extirpation extends from the skin fistula to the inner side of the thorax wall and on or in the lung where the bronchial fistulas

are sutured. The wound cavity is powdered with penicillin and sulphathiazole. Primary suture in layers with silk. Daily aspiration of wound exudate. Systemic treatment with penicillin and sulphathiazole.

5 case reports are presented. With one patient drain had to be used on account of persistent infection. The microbes were in this case resistant to penicillin and sulphathiazole. In all other cases primary healing was achieved. In less than a month all patients were cured of an illness lasting 6—12 months.

The operation causes no deformity of the skeleton, gives best possible lung function and easiest postoperative treatment.

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## **Pulmonary Abscesses Attended With Pleural Complications.**

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Pulmonary abscesses with pleural complications present a number of problems which have not been fully elucidated in the literature. The disagreement mostly concerns the prognosis, but the views on the therapy are also extremely divergent. Little appears to be known about the factors predisposing to the pleural complications or about certain features of the clinical, radiological, and bacteriological aspects of the disease.

### **Writer's Material.**

The studies to be reported comprise one hundred consecutive cases of pulmonary abscess observed from 1944 to 1946 incl. Of the 100 cases 32 required treatment for spontaneous pleural complications, bacterial in 27. All forms of pulmonary abscess are included in the material, also abscesses co-existing with bronchial carcinoma, bronchiectasis etc., when the syndrome is dominated by the abscess. The diagnosis of an abscess has been based on definite criteria like an unquestionable history, typical X-ray signs and operative or post-mortem findings. Bronchiectatic and other secondary abscesses which have not been ascertained until the patient has reached the operating table or the post-mortem room have not been included. The same applies to totally or partly intra-pulmonary suppurations following war injuries. Tuberculosis

has been ruled out in all cases by negative cultivation from the sputum, pleural effusion, and the contents of the abscess, in some cases by microscopical examination of biopsy specimens.

### Form of Pleural Complications Attending Pulmonary Abscess.

The following types of pleural complications have been observed:

(1) Pneumothorax, limited.....	1 case
(2) Valvular pneumothorax, total .....	1 »
(3) Sterile, large effusion, limited .....	1 »
(4) Sterile (?), putrid effusion, total .....	2 cases
Non-bacterial complications .....	5 cases
(5) Perforation to chronic empyema .....	1 case
(6) True interlobar empyema .....	1 »
(7) Parietal empyema, limited .....	11 cases
(8) Pyopneumothorax, limited .....	2 »
Limited empyemas .....	15 cases
(9) Total empyema .....	7 cases
(10) Total pyopneumothorax .....	5 »
Total empyemas .....	12 cases

Pneumothorax without effusion occurred in two cases. In both instances the patients had high fever and copious, fetid expectoration when the complication set in. The air in the pleural cavity was foul-smelling. The pneumothorax persisted for one and five weeks respectively without signs of pleurisy supervening. This condition is uncommon, but by no means unknown; EGGERs has reported 10 cases and PICOT 3.

Three cases had enormous serous or cloudy effusions revealing a high content of leukocytes upon microscopical examination. Repeated aerobic and anaerobic cultivations were made with negative results. In two cases the effusion was putrid. No special investigations were made to find spirochaetes. Therefore, they may have been cases of spirochaetal empyemas. A few such cases have been published (LÉON-KINDBERG & MONOD, p. 101). Of course one cannot either rule out bacterial empyemas, greatly "diluted" by reactive effusion.



In the remaining 27 cases it was a question of purulent pleurisy, total in twelve cases, and more or less limited in fifteen. Pyopneumothorax was observed in 7 patients, two of whom had limited and 5 total pleural infections. In 3 additional cases there was air above the fluid, but possibly it was caused by puncture prior to hospitalization.

### Frequency of Pleural Complications Attending Pulmonary Abscess.

Thirty-two cases of pleural complications among 100 patients affected with pulmonary abscess (32 per cent.) is a high percentage compared with most other materials. Even if only the genuine empyemas are included, the incidence (27 per cent.) is still higher than usually stated. ALLEN & BLACKMAN found 9 putrid empyemas among 90 cases of pulmonary abscess (10 per cent.), ROSENBLATT 12 among 94 (12.8 per cent.), CUTLER & GROSS 14 among 100 (14 per cent.), and VALLE 37 in a material of 244 cases (15.2 per cent.). An incidence corresponding to that found in the present material has been observed by NEUHOF & WESSLER who report 24 among 100 (24 per cent.) and NEUHOF & TOUROFF who found 10 among 37 (27 per cent.).

Deducting the bronchiectatic abscesses in the writer's material, we arrive at 24 cases of pleural complications among 90 patients suffering from pulmonary abscess. Of these 24 cases 19 were empyemas, *i. e.* an incidence of empyema of 21.1 per cent.

It has been emphasized several times that putrid empyemas are nearly always due to pulmonary abscesses (NEUHOF & STATS, STRIEDER & LYNCH). During the 3-year period covering the writer's investigations 12 putrid empyemas were treated, but not included in the material, because the diagnosis of abscess could not be established with certainty, although several factors indicated an abscess as the underlying cause of the empyema.

### Nature of the Causative Pulmonary Abscess.

Table 1 sets out the occurrence of pleural complications in the various types of pulmonary abscess.

In the group of primary putrid abscesses are classified the so-called postpneumonic abscesses, as a more detailed history in all cases indicates that the abscess has been primary. In 6 cases the abscess followed major operations; three of the patients got em-

Table 1.

*Occurrence of Pleural Complications in Various Types of Pulmonary Abscess.*

Type	Pulmonary abscesses	Pleural complications	
		Number	Per cent.
Primary putrid . . . . .	68	19	28
Questionable genesis . . . . .	11	2	18
Without bronchial affection . . . . .	79	21	27
Bronchial carcinoma . . . . .	8	2	25
Bronchial adenoma . . . . .	1		
Stenosing non-specific bronchitis . . . . .	2	1	50
With bronchostenosis . . . . .	11	3	27
Bronchiectasis . . . . .	10	8	80
Total	100	32	32

pyema. Five patients had previously been suffering from diseases of the mouth or throat; of them one got empyema. In no case did the abscess follow tonsillectomy. In two instances, both complicated with empyema, the pulmonary abscesses occurred in persons mentally deranged; one of them had been fed with a tube and the other one had attempted suicide with barbituric acid. In one case, also complicated with empyema, the pulmonary affection was preceded by puerperal infection.

*As apparent from Table 1 the incidence of pleural complications is the same in the presence as well as in the absence of stenosing bronchial affection (27 per cent.).* A particularly high incidence of pleural complications is encountered in cases of bronchiectatic abscesses (80 per cent). Presumably this is, however, merely due to the criteria of selection. If the material had comprised the numerous small bronchiectatic abscesses ascertained at operation or autopsy, the incidence of pleural complications would sooner have been lowest in this group.

#### **Incidence of Pleural Complications in the Two Sexes, in the Individual Age Groups and in the Various Localizations of the Abscesses.**

The material comprises 74 cases of pulmonary abscess in men and 26 in women. Pleural complications occurred in 26 and 6 re-

spectively (34 and 23 per cent.). Accordingly, there is no definite difference between the occurrence of the complications in the two sexes.

The age of the patients and its influence on the incidence of the pleural complications is analysed in Table 2:

Table 2.

*Age of the Patients and its Influence on the Incidence of Pleural Complications.*

Age	Pulmonary abscesses	Pleural complications	
		Number	Per cent.
0—1.....	1	1}	100
1—14.....		2}	
15—19.....	2	2}	
20—29.....	10	2}	24
30—39.....	27	7}	
40—49.....	22	5}	
50—59.....	23	10}	40
60—69.....	14	4}	
70—79.....	1	1}	
0—79.....	100	32	32

Children and adolescents appear to exhibit the highest incidence of pleural complications. It is true that these age groups are sparsely represented in the material, but even so the high incidence is hardly due to pure chance. At any rate SEMB (p. 429, 432) and other authors report the same experience. The comparatively high incidence in elderly patients (above 50 years of age), on the other hand, does not appear to have been reported earlier. The phenomenon is probably due to the comparative frequency of bronchiectatic abscesses in elderly persons.

The influence of the localization of the pulmonary abscesses on the incidence of pleural complications is illustrated in Table 3.

It is evident that pleural complications are far less common in abscesses of the upper lobes (16—20 per cent.) than in abscesses of the lower lobes (45—48 per cent.). The right middle lobe exhibits the same figures as the upper lobes (20 per cent.). The right and left lung exhibit the same incidence of pleural complications. The higher frequency of complications in cases of abscesses of the lower lobes does not appear to have been pointed out earlier. It is, however, quite natural in view of the greater respiratory

Table 3.

*Localization of Abscesses and its Influence on the Incidence of Pleural Complications.*

Localization	Pulmonary abscesses	Pleural complications	
		Number	Per cent.
Right upper lobe .....	31	5	16
Left upper lobe .....	15	3	20
Upper lobes .....	46	8	17
Right middle lobe .....	5	1	20
Right lower lobe .....	29	14	48
Left lower lobe .....	20	9	45
Lower lobes .....	49	23	47
Right lung .....	64	20	31
Left lung .....	34	12	32
Right and left lung .....	2		
Total	100	32	52

excursions of the lower lobes against the bony thorax and the consequently smaller chances of synechiae in the basal parts of the lungs.

A study of the size of the abscesses failed to reveal anything definite regarding its influence on the occurrence of pleural complications. It rather appears as if large abscesses involve complications more often than small ones. Nothing can, however, be said with certainty, as more than half the cases had to be rejected in this part of the investigations.

### **The Pathogenesis of Pleural Complications Attending Pulmonary Abscess.**

A rupture was demonstrated with certainty in 21 out of the 32 cases (66 per cent.). In 8 patients the rupture was discovered upon operation and in 4 at the post-mortem examination. Spontaneous escape of air was the diagnostic criterion in 9 cases, 7 of pyopneumothorax and 2 of pneumothorax without effusion. In all cases the amount of air was so enormous that bacterial production of gas is extremely unlikely.

In 4 additional cases the clinical and radiological symptoms, to be described below, were so characteristic of sudden rupture, that they alone were considered sufficient to make the diagnosis very probable.

In 7 of the 32 cases (22 per cent.) it cannot be decided whether it was a case of rupture or of lymphogenous propagation from the abscess to the pleura. In cases of doubt the course of the disease, and particularly of the pleural infection, hardly affords any help in the matter of deciding the pathogenesis of the pleural infection. As mentioned above the material includes two cases of pneumothorax without infection of the pleural cavity in spite of unquestionable perforation of the abscess. In one of the cases with a serous effusion autopsy revealed a rupture, 1 cm. in length, in the wall of the abscess. Although the rupture occurred at least 1 week prior to death, it was not possible to demonstrate bacteria in the effusion.

Among general diseases supposed to predispose a case of pulmonary abscess to pleural complications there is reason to emphasize diabetes mellitus particularly. Two patients with pulmonary abscess were suffering from this disease. One got an empyema, but the other one exhibited no pleural complications.

### The Character and Bacteriology of the Pleural Effusion.

The following bacteria have been demonstrated in cultures from the empyemas:

non-hæmolytic streptococci .....	12 cases
»                   »           + <i>B. proteus</i> .....	1 case
»                   »           + Pfeiffer's bacillus .....	1 »
»                   »           + <i>staphylococcus aureus</i> .	1 »
»                   »           + Gram-negative non-fer-	
menting rods .....	1 »
»                   »           + hæmolytic streptococci	
+ <i>staphylococcus au-</i>	
reus + pneumococci	
type 22 .....	1 »
hæmolytic streptococci .....	3 cases
<i>staphylococcus aureus</i> .....	2 »
pneumococci type 1 .....	1 case
pneumococci type 8 .....	1 »
<hr/>	
Total	24 cases

As already mentioned 5 patients did not exhibit definite bacterial complications. Lastly, no bacteria could be cultivated from 3 cases of empyema. Shortly before entering the hospital they had been injected with penicillin into the pleural cavity.

Putrid effusion was demonstrated in all 17 cases of non-hæmolytic streptococci, whether the latter were alone or associated with other bacteria. The case of pneumococci, type 1, in the pleural cavity also had a putrid effusion. In addition, there was a putrid, serous effusion in two cases without demonstrable bacteria in the pleural cavity. In all 3 cases of empyema treated with penicillin, the pus had originally been putrid. Among 30 cases of effusion the latter was putrid in 23 (77 per cent.). As mentioned already the department also treated 12 cases of putrid empyema without demonstrable pulmonary abscess during the same period. Of the total of 35 putrid effusions, 23 (66 per cent.) are thus due to unquestionable pulmonary abscesses.

Seven instances failed to exhibit putridity of the pleural effusion. Three of them had hæmolytic streptococci, two staphylococci and one pneumococci, type 8, whereas no bacteria were demonstrable in the last case (serous effusion). One of the patients was suffering from bronchial carcinoma, another had bronchiectasis and in a third case the disease followed upon puerperal sepsis. The remaining four patients with non-putrid effusions had typical putrid pulmonary abscesses with putrid sputum. In 3 of the cases of putrid sputum and non-putrid pleural effusion, a definite rupture of the abscess was demonstrable.

In 10 among 18 cases of definite rupture of the abscess, pneumococci were demonstrated in the sputum. In merely one of the cases was it possible to find the pneumococci in the pleural effusion (type 1), but this could not be done in 9 cases (types 2, 3 (twice), 18, 19, 22, 28, 33, 37). The patient with pneumococci of type 8 in the pleural effusion failed to exhibit pneumococci in the sputum; there was no definite rupture of the abscess. In 3 of 4 cases followed up the pneumococci (type 3 (in two cases) and type 18) persisted in the sputum for at least two to three months after the acute stage.

As regards the other microbes of the sputum, repeated examinations of 7 cases of definite rupture of an abscess only revealed conformity with the cultivation from the empyema in 3 cases. Accordingly, the conditions of life for the microbes in the pleural cavity appear to be widely different from those in the lungs.

## Symptomatology.

In typical cases 3 stages of the disease are easily distinguishable. The first stage, up to the onset of the pleural complications, usually does not differ much from the ordinary syndrome of pulmonary abscesses: in one-third of the cases, however, the typical expectorate was missing during this stage. The transition to the second stage followed after one to three weeks' illness, but was only distinctly demonstrable in 15 of the cases, *i. e.* in less than half the patients. These 15 exhibited a rather sudden exacerbation of their condition, displaying dyspnoea, cyanosis, stitch, dullness, sometimes bruit de pot felé, and Hippocratic succussion, displacement of the mediastinum, a further elevation of temperature, and at times a distinctly intoxicated, septic look. In other cases the syndrome resembled a severe croupous pneumonia. A sudden cessation of expectoration was observed in 5 cases. A marked tenderness of the thoracic wall was found in 9 cases, oedema in 2. In 3 cases the patients were not hospitalized until the empyema had perforated into the subcutaneous tissue. An insidious transition to the second stage occurred in 17 patients. In these cases the condition was marked by the gradual onset of exacerbation, and it was only after the lapse of several days that the above-mentioned symptoms of pleural affection were manifest. Most of these patients had no rupture of the abscess or else they had limited pleural infections. Five of them, however, exhibited unquestionable perforation and total empyema; probably energetic chemotherapy was contributory in masking the symptoms. As a rule putrid infections affect the general condition most.

The 3rd stage of the disease is represented by the period following drainage and will therefore be dealt with under the heading: results of treatment.

## Roentgenological Aspect.

In the present material as in that reported by ALEXANDER roentgenography has in most cases revealed a large pleural effusion without a fluid level after the onset of the pleural complication. Distinct outlines of the abscess were only observed in 10 cases; in the remaining cases the abscess was covered by the effusion at the outset. In 3 of the patients of the latter category it could be visualized immediately after drainage of the pleural

cavity; in 2 it was not visible until 3—4 weeks later, when the lung had reexpanded and the abscess had reached the chest-wall. At the same time there was a sudden, marked increase in the expectoration, a sign that the hitherto sufficient discharge from the abscess to the pleural cavity had become obstructed. In 2 cases of abscesses of the upper lung field attended with pyopneumothorax, X-ray gave a picture which according to LEZIUS is typical of the condition, but which is probably not widely known. It reveals a pulmonary abscess with fluid level and adhesions to the thoracic wall; above and below the abscess there are pleural effusions with fluid levels in two compartments, separated by the adhesions issuing from the abscess.

### Diagnosis.

In typical cases the clinical diagnosis of pleural complications did not cause any difficulties. Roentgenograms and pleural punctures were required to prove the diagnosis. At times it was necessary to perform repeated punctures, before any effusion was found, as parts of the lungs often adhere to the pleura and the localization of such adhesions is frequently incalculable in the presence of pulmonary abscesses, particularly of the basal parts. In one case (of bronchiectasis) the empyema could not be diagnosed until it had perforated into the subcutaneous tissue. In another case the diagnosis was not passed until explorative thoracotomy revealed the condition.

In patients entering the hospital with empyema, the diagnosis of the causative pulmonary abscess was based on a careful taking of the history with regard to the conditions predisposing to abscess, examination of the sputum, demonstration of putrid effusion in the pleural cavity, operative findings and the course of the disease. In several cases a suspicion of pulmonary abscess could not be verified. According to the experience gained by the writer and several authors (HARTWELL, ISELIN) pyopneumothorax is more indicative of a pulmonary abscess which has ruptured to the pleural cavity than of a primary empyema forcing its way to the bronchi.

### Treatment.

The main principle has been first and foremost to treat the pleural complication. Whether it was definitely bacterial or not, all the cases received sulfa drugs and (from 1945) penicillin. In



cases of pneumothorax without effusion exsufflation has been performed until low negative pressure (— 2—4 cm. of water). In the case of valvular pneumothorax permanent exsufflation through BOGASON's cannula was necessary for 5 days. Serous and cloudy, sterile effusions have been treated with thoracocentesis and sometimes with intra-pleural injection of alfasol (trade name for neutral solution of sulfa drug) and/or penicillin. The same treatment could be applied to the empyemas in one case of bronchial carcinoma and in an infant. Otherwise the empyemas were treated with drainage soon after hospitalization. In 6 cases the primary drainage was intercostal, either by the method of BÜLAU or by HANSEN's drain, introduced while closed through a small incision. In addition, there were 3 patients who had been treated with BÜLAU's drainage prior to admission. Rib resection was, however, the principal method in treating empyema and pyopneumothorax. In 15 cases this intervention was performed primarily or following a few thoracocenteses, and in 5 cases it was secondary (after Bülau drainage had been attempted).

In cases of fresh empyemas the rib resection was performed according to the closed method: Prior to the incision of the pleura loose sutures are applied to the intercostal musculature or the broad muscles of the back. Following a sample puncture a knife is plunged through the pleura and a sucker immediately introduced into the hole which is further closed with firmly applied gauze. After part of the pus has been aspirated the sucker is removed and a drain introduced immediately. Beforehand the latter has been connected with an underwater drainage bottle. The preliminary sutures are tied at once. As a rule the intervention was performed under local anaesthesia. The patients, were therefore, capable of regulating the respiration at will and thus contributed to preventing air being sucked into the pleural cavity.

In cases of limited empyemas the incision was, usually broader, the cavity explored and a perforation of the abscess if any, opened with a broad incision. Lately the same method has been tried for fresh empyemas also. In order to prevent mediastinal fluttering etc. universal anaesthesia has been employed with tracheal intubation and controlled respiration.

In all cases the empyemas were after-treated with suction drainage. Cautious irrigation with chloramine, alfasol or penicillin was performed where it could be managed, *i. e.* in most instances in spite of the bronchial fistulas.

Chronic residual cavities were treated with protracted suction drainage, if it was possible to preserve a negative pressure, that is in cases where the bronchial fistulas were wholly or almost closed. Otherwise the chronic cases were treated with plastic surgery, as a rule by the method of ROBERTS, implantation of muscles, or thoracotomy with radical extirpation of the walls of the cavity, suture of the bronchial fistulas and primary closure (HANSEN (b)). OVERHOLT's plumbage was used in one case and crushing of the phrenic nerve in one. A total of 8 patients were submitted to secondary operation.

A special treatment of the pulmonary abscesses during the acute stage was considered to be required in cases where roentgenograms, sputum, temperature, and general condition indicated incomplete drainage to the pleural cavity. Apart from penicillin and sulfa drugs the treatment applied was postural drainage, bronchoscopic aspiration and — in three cases — aspiration from the abscess through adherent parts of it or by means of a thoracocentesis apparatus or by the method of SEMB (b).

### Results of Treatment.

After a follow-up period of 1—3 years the results are as follows:

(1) Cured .....	19 cases (59.4 per cent.)
(2) Chronic bronchial fistula .....	1 case ( 3.1 per cent.)
(3) Died in the department .....	8 cases (25.0 per cent.)
(4) Died after discharge .....	4 » (12.5 per cent.)
<hr/>	
Total 32 cases	

The patients classified in groups 1 and 2 are all fully capable of working and feeling well. The patient with the bronchial fistula does not want re-operation, as it only inconveniences him slightly, the secretion amounting to 1—2 grammes during the 24 hours.

Among the lethal cases 6 died 3 to 14 days after having entered the hospital, 1 death occurred after a month's stay in hospital and one 5 months after hospitalization. In 7 of these 8 cases autopsy revealed that the pleural complications had been satisfactorily treated, whereas one exhibited retention of pus in the empyema which was multilocular. In this case as well as in the remaining 7, death was primarily due to the intra-pulmonary disease which always remained without the reach of surgical

treatment. In 5 instances there was bronchiectasis, bilateral in 3, in 2 gangrene of more than one lobe, and in 1 bronchial carcinoma with distant metastases. If these affections were to receive effective treatment, they would at least have required major intra-thoracic interventions which none of the patients would have been able to stand.

Of the patients of category 4 dying subsequent to the discharge from the department, 3 had still small bronchial fistulas, but none of them actual intra-thoracic cavities, whereas the empyema as well as the pulmonary abscess had been cured in the fourth case. Because of the presence of a bronchial carcinoma the only treatment applied in this case was repeated punctures; the carcinoma was inoperable and led to death one year after discharge. One patient died from a fresh, cavernous, bilateral pulmonary tuberculosis which did not manifest itself by X-ray or bacteriological examination until four months after discharge. Two patients died from cerebral abscess 3 and 14 months respectively after the acute disease. One of them had been feeling well for 6 months before neurological symptoms set in. Still, a persistent bronchial fistula issuing ample secretion had indicated continuous intra-thoracic activity, although it was impossible to demonstrate a cavity, not even by operation. Of the 8 patients who were submitted to secondary operation for persisting residual cavities, none died post-operatively. Two died later (cerebral abscess, bronchiectasis).

### Prognosis.

The literature displays marked disagreement on the prognosis of the pleural complications attending pulmonary abscesses, particularly of empyemas caused by perforation. According to SAUERBRUCH (II, p. 809), SAUERBRUCH & O'SHAUGHNESSY (p. 62), and LÉON-KINDBERG & MONOD (p. 198) the condition is very dangerous. SERGENT & ISELIN report 9 deaths among 11 patients. SEMB (p. 449) reports a lethality of total pyopneumothorax and pleural phlegmon to be 80—90 per cent. GRAHAM, SINGER & BALLON (p. 741) as well as EGGERS, on the other hand, consider the prognosis to be far more favourable, stating that the majority of the patients recover.

According to SERGENT & ISELIN it is of decisive prognostic significance whether the infection occurs in a free or demarcated

pleural space. They consider perforation into free pleural space to give extremely gloomy prospects. This has not, however, been the case in the writer's material. Among the 7 cases of pyopneumothorax there was only one death, a patient with an inoperable bronchial carcinoma. In this case the pleural affection was even demarcated. There was no death among the 5 patients with a total pyopneumothorax.

A classification of the material according to the state of the pleura would appear as follows:

Limited pleural affections ..	17 cases	.....	15 empyemas
fatal .....	11 »	(64.8 %)	9 »
Non-limited pleural affections	15 »	.....	12 »
fatal .....	1 case	(6.7 %)	1 »

In the only case of total pleural affection with fatal issue, death occurred as long as 14 months after the acute disease. It was due to a cerebral abscess and the empyema had been obliterated long ago.

According to the present material the factor of greatest prognostic significance appears to be the presence or absence of a pulmonary affection prior to the onset of the abscess:

No pulmonary affection prior to the abscess	21 cases	
fatal .....	4 »	(19.1 %)
Chronic pulmonary affection prior to the ab-		
scess .....	11 »	
fatal .....	8 »	(72.8 %)

Similarly, it was the presence of previous pulmonary affections that involved the adhesions which according to the table appear to aggravate the prognosis. Among the 4 patients without a demonstrable chronic pulmonary affection, 2 died of cerebral abscess and 2 of fulminant pulmonary gangrene. Only in one of the 4 cases was death decisively influenced by the pleural complication (pulmonary gangrene with a multilocular, not well-drained empyema).

A prognostic factor of the utmost importance is — as also emphasized by GRAHAM — the nature of the pleural effusion:

Putrid effusion .....	23 cases	
fatal .....	10 »	(43.5 %)
Non-putrid effusion .....	7 »	
fatal .....	(1) case	(14.3 %)

There was only one death among the patients with a non-putrid effusion and it was due to bronchial carcinoma; the effusion had been cured long ago and had not re-collected.

All 12 deaths occurred among men. They ranged in age from 28 to 64 years, 11 were more than 40, 9 more than 50. The mortality among patients above 40 years of age is 55 per cent, in patients older than 50 it is 50 per cent. It is worth mentioning that a 76-year-old man exhibiting a pyopneumothorax was cured.

A prognostic sign of the utmost clinical value is the amount of sputum brought up following pleural drainage. If the expectoration ceases in the course of a few days the prospects are far better than in cases where it persists. This corresponds to the absence and presence respectively of chronic pulmonary disease.

### Summary.

The writer reports a material comprising 100 cases of pulmonary abscess of whom 32 were attended with pleural complications, 27 with empyema, and 7 with pyopneumothorax. The incidence of pleural complications is the same in the presence and absence of stenosing bronchial affections (Table 1). They are most common in connection with abscesses of the lower lobes (Table 3). Definite rupture of the abscess was demonstrated in 21 cases (66 per cent.). Putrid effusion was found in 23 cases, 17 of whom exhibited non-hæmolytic streptococci. In a large number of cases there will be complete incongruence between the bacterial findings in the sputum and those of the pleural effusion, even if there is a definite perforation of the abscess. As a rule the pleural complications set in when the disease has persisted for 1 to 3 weeks. The treatment has primarily been directed against the pleural complication which has quickly been subjected to treatment, as a rule rib resection by a closed method and suction drainage. In 8 cases pneumonotomy was performed at the same time as the pleural drainage. Secondary operation was required in 8 cases. Eight patients died in the department, 4 after discharge. One of the patients still has a small bronchial fistula, but the others (19) are well. The follow-up period ranges from 1—3 years. The prognosis is serious in patients already affected with a chronic disease of the lungs; it was chiefly such patients who died. Otherwise pleural complications attending pulmonary abscesses usually run a benign course when adequate drainage is provided.

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## **The Drawbacks Encountered in Local Treatment of Pleural Empyema With Chemotherapeutic and Antibiotic Agents.**

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### **Introduction.**

Shortly after the sulfonamides came into use they were also tried in the local treatment of pleural empyema. During the years preceding the last world war individual successful treatments were reported from England, U. S. A., and Germany (8, 4, 12). By more advanced eireles this therapy was, however, regarded with seep-ticism (13, 42), and the few later reports (3, 20, 23, '30, 34) have not contributed to inerease the optimism. It is true that in some cases of tuberculous empyema due to mixed infeetion, the latter has yielded to this treatment as reported int. al. by Scandinavian authors (THUNE (38), BRUCE et al. (9)), but in non-tubereulous eases the effect is often doubtful. ARNESSEN (3) of Sarpsborg in Norway has treated the majority of his cases (35 out of 44) with puncture only. It is his impression that sulfonamide injected into the intrapleural space has played no rôle in the cases where he has employed it. His compatriot FROSTAD (20) did not either succeed in achieving the object in his case by this treatment alone. In Denmark KRIEGER LASSEN (34) has tried the method in 10 cases. Among 4 children 3 (affected with 4 empyemas) were eured by thoracoeenteses and injections with alfasol (trade name for a

neutral solution of sulfonamide), whereas one died. Children are, however, so often cured of empyemas with punctures alone (26, 33), that it is hardly warrantable to estimate the effect of the sulfonamide on the basis of these cases. Among KRIEGER LASSEN's 6 adult patients treated with alfasol 3 were cured, whereas the remaining 3 had to be operated on later (Nos. 7, 8 and 10, the two last-mentioned ones being identical with case histories Nos. 5 and 9 respectively reported below). A publication of the utmost interest concerning the local application of sulfonamides to empyema is the report of TILLET et al. (49): In 5 out of 6 cases of pneumococcal empyema they found the microbes in the pleura cavity to be chemoresistant to sulfadiazine. These 5 patients had previously received peroral sulfadiazine for their pneumonias. In the 6th case the pneumonia had primarily been treated with penicillin, and the pneumococci of the empyema were not resistant to sulfadiazine (nor to penicillin). Similar phenomena have been observed in cases of streptococcal empyema.

After penicillin came to be used clinically in 1941 it was the antibiotic agent which ordinarily was tried in the local treatment of empyema. The first reports were extremely enthusiastic and a certain number of authors could submit each a few examples of a cure resulting exclusively from local injections of penicillin following thoracentesis (6, 7, 11 a, 21, 25, 27, 29, 35, 45, 49). However, authors with a larger material at their disposal and wider experience in the treatment of empyema, quickly advanced statements to the effect that also this kind of therapy, when employed alone, was in most cases unable to lead to the goal. Permanent drainage is therefore as a rule recommended (5, 11, 15, 16, 32, 39, 40, 47) in cases where the empyema is not cured quickly. In tuberculous cases, however, it is of course right to continue as long as possible without drainage which in several cases can be avoided altogether (9, 11, 47).

The reason why most authors warn against protracted attempts at punctures of non-tuberculous empyemas is the difficulty in effectively tapping the effusion after the earliest stage of the empyema. If large amounts of effusion remain in the pleural space there is a risk of complications, particularly that of a chronic empyema. Moreover, the slight capacity of the penicillin for diffusion and penetration may cause the persistence of encapsulated foci in retained fibrinous and necrotic masses. From these foci the infection will then be maintained.



There is, on the other hand, no doubt about the great advantages of local application of penicillin in *quite fresh cases of empyema*. Although penicillin — like sulfa drugs — when applied universally, may reach the pleural cavity in considerable concentrations (5, 41, 46), perhaps chiefly when given in “booster doses” (22) (intramuscular injection of 4—5 times the normal dose), empyemas decisively belong to the group of infections which also should receive local treatment (14, 31). In the pleural space as well as elsewhere in the organism (28) penicillin may have a powerful preventive effect in cases where the infection has not set in yet and an abortive effect in cases of quite fresh infection. This has been particularly confirmed by experience gained from war wounds of the chest (1, 2, 42, 47). *A fully developed purulent infection* can also be effectively fought with penicillin, but it is in these cases that the above-mentioned difficulties arise. *The more advanced the infection, the more difficult the performance of the local treatment.*

It is difficult to set up any general rule for the length of time which one can go on employing thoracocentesis and injection with sulfonamide and/or penicillin. The writer will endeavour to elucidate this problem in the following pages by submitting a series of case histories, chiefly representing examples of an over-estimation of the capacity of the treatment or of an erroneous technique in carrying it through. In addition, an illustration is given of certain of its fundamental, often inevitable drawbacks. So far more has been said of the advantages of the treatment than its disadvantages, and in Denmark only one voice appears to have been raised in warning (24). In order to be able to estimate the treatment fully, one must of course be equally familiar with its drawbacks and risks as its advantages.

### Material and Case Reports.

During the 2½ years which have elapsed since the Clinic of Thoracic Surgery was opened on January 1, 1944 a total of 108 cases of non-tuberculous pleural empyema have been admitted. Of this number 16 had received intrapleural injections of alfasol or penicillin prior to their admission. In addition, 10 patients have received the same treatment in the Clinic during the acute stage of the empyemas. In the main the course of the disease in these 10 cases has confirmed the advantages of the treatment which are

known from the literature. In most cases it was possible to *mitigate the acute infection*. No disadvantages were observed in these cases. The punctures were, however, only continued for a short time. As soon as they showed inability to evacuate the pus sufficiently, permanent drainage was established and the empyema treated with continuous suction and intermittent irrigation. All 10 empyemas were cured, 9 with drainage, and only 1 with punctures only.

Of course the 16 cases who had received local treatment elsewhere prior to admission do not afford a fair picture of the capacity of the therapy. Their case histories are, however, fitting to display the drawbacks of the method, as they have in most instances been transferred to a special department because of difficulties or complications.

In 4 cases the local treatment was continued for a long time in spite of the presence of a (nearly) total empyema.

*Case 1.* Male, aged 36 (211/46). Taken ill on Apr. 1, 1946 with symptoms resembling those of pneumonia. On Apr. 26 he was admitted to a medical department. Pleural puncture yielded fetid pus. On May 8 the patient was transferred to a surgical department, where a thoracocentesis was performed at once and repeated on May 15. Each time 100,000 units of penicillin were injected. As his condition remained poor and fever persisted, the patient was transferred to the Clinic of Thoracic Surgery on June 18, 1946. Immediate rib resection (closed method) with removal of more than 2 litres of extremely fibrinous, putrid pus from an empyema cavity which appeared to be total. At the same time incision of a phlegmon of the chest-wall arising from the puncture canals. Cultivation from the pus from the pleural cavity was negative, also for anaerobic organisms. Cultivation for tubercle bacilli was also negative. (Later cultivation yielded staphylococcus aureus and *B. alkaligenes*.) The fetid expectorate ceased immediately after the drainage had been established. X-ray now revealed distinct outlines of an abscess in the lung which, however, subsided spontaneously. A revision of the history indicates a primary, putrid pulmonary abscess. It was not until July 25 that the lung had re-expanded so that the suction drainage could be discontinued. Discharged on August 16 (followed up for some time out of regard to the regression of the abscess).

*Case 2.* Male, aged 62 (65/46). Taken ill about Dec. 1, 1945 with symptoms of pneumonia or pulmonary abscess. On Dec. 9 he entered a medical department where putrid pus was found in the pleural cavity on Jan. 3, 1946. Since then almost daily thoracocenteses with injection of penicillin (100,000 units). As his condition went downhill, he was transferred to the Clinic of Thoracic Surgery on Feb. 6. Immediate rib resection with removal of large amounts of thick, putrid pus (cultivation yielded facultative anaerobic non-hemolytic strepto-

cocci and anaerobic Gram-negative rods) from an almost total cavity. In addition, a phlegmon arising from the paths of the puncture needle had to be incised. Blood transfusion for infection anaemia (haemoglobin 66 per cent.). Suction drainage. Discharged on May 24. Ambulatory after-treatment for a fistula, 10 cm in length, which gradually closed.

*Case 3.* Boy, aged 14 months (231/45). Taken ill on Jan. 15, 1945. On Jan. 20 he entered a children's hospital where a diagnosis was made of pneumococcal pneumonia, type 14, and empyema. On Jan. 30 he was transferred to a surgical department where a thoracocentesis was performed every other day with injection of 5—10 cc. of alfasol, 20—40 per cent. As the pus gradually grew too thick to be aspirated through a cannula, the patient was transferred to the Clinic of Thoracic Surgery on Feb. 25. Immediate rib resection. The empyema cavity is almost total, containing ample, extremely fibrinous pus (pneumococci type 14). Suction drainage. Discharged on May 19, with an insignificant fistula which closed in the course of an ambulatory treatment.

*Case 4.* Boy, aged 4½ (225/45). Following measles pneumonia on Jan. 13, 1945. Admitted to a fever hospital on Jan. 15 (pneumococci type 1). On Feb. 12 empyema was diagnosed. Treated with six thoracocenteses and injection of alfasol (10—20 cc., 40 per cent.). As the pus grew too thick the patient was transferred to the Clinic of Thoracic Surgery on March 6. Immediate rib resection. An almost total cavity filled with large amounts of an extraordinarily thick pus (pneumococci type 1), and fibrinous masses. In order to remove these enormous quantities it was necessary to enlarge the thoracotomy wound so that the pleural space could be thoroughly cleaned. There was a broncho-pleural fistula which, however, closed satisfactorily two weeks after the operation. Suction drainage. Discharged on May 24, when the wound had healed.

A common feature of these four case histories is that in spite of the presence of almost total cavities the empyemas remained under local treatment without effective evacuation for a month or more before the patients were transferred to the Clinic of Thoracic Surgery. Another characteristic phenomenon is the marked production of fibrin in the cavities treated with penicillin as well as those treated with alfasol. It is true that this is a common occurrence in pneumococcal empyemas, although it is seldom as marked as in the two children (Nos. 3 and 4), but in cases of putrid empyemas caused by pulmonary abscess as in the two men (Nos. 1 and 2) the production of fibrin is usually far slighter, also following protracted puncture treatment. In the two last-mentioned cases (Nos. 1 and 2) the punctures had caused quite considerable phlegmons of the chest-wall. Lastly, the broncho-pleural fistula in the last case (4) is worth emphasizing; in all probability

it indicates that the contents of the empyema were making their way out through the respiratory tract.

By rib resection and suction drainage all four patients were successfully cured, but not until 3—4 months after their admission to the Clinic of Thoracic Surgery and 4—5 months after the empyema had been diagnosed. This is 2—3 times the period normally required by the Clinic for the treatment of fresh empyemas.

In two additional cases the empyema was not total, but very deep, so that the lung was compressed almost as far as the hilus — in spite of a protracted period of aspirations.

*Case 5.* Male, aged 54 (118/44). (Cf. KRIEGER LASSEN, Case history 8). Taken ill on Jan. 27, 1944 with symptoms of pneumonia. On Feb. 1 the patient was admitted to a fever hospital. Pneumococci type 2. On Feb. 14 pus was found in the pleural cavity. From Feb. 29 to March 12 treated with 5 thoracocenteses with injection of 20—40 cc. of alfasol, 40 per cent. On March 16 transferred to the Clinic of Thoracic Surgery because of a persistent fever. Immediate rib resection. Large amounts of blood-stained fibrinous pus (pneumococci type 2) in a cavity, four times the size of a closed fist, of a paravertebral and high situation. This cavity resulted from the collapse of the entire middle portion of the lung as far as the hilus. Broncho-pleural fistula which persisted for a month. Suction drainage. Discharged on May 13 with a small fistula which healed in the course of ambulatory treatment.

*Case 6.* Male, aged 76 (609/45). Following amputation of the thigh (for gangrene) on May 25, 1945 at a surgical department the patient exhibited a putrid pulmonary abscess complicated by a putrid empyema, ascertained on June 28. Treated with numerous thoracocenteses and injections of alfasol (10—40 cc., 40 per cent.). The general condition improved, but the empyema and expectorate persisted and the fever returned, so the patient was transferred to the Clinic of Thoracic Surgery on Sept. 7. Postural drainage. On Sept. 12 rib resection (closed method). The cavity was found to be three times the size of a closed fist, of a basal and lateral situation, compressing the lung more than halfway down to the hilus. The pus was thin and yellow (hæmolytic streptococci and staphylococcus aureus), no longer putrid. At the same time incision of a phlegmon of the chest-wall arising from the puncture canals. A *broncho-pleural fistula* caused symptoms for a months. The daily amount of sputum decreased from about 150 cc. to 20—40 cc., but then remained in the vicinity of this quantity. (X-ray including bronchography failed to find an explanation.) Suction drainage. Discharged on Dec. 14 with a small narrow fistula (8 cm.).

These two patients remained under local treatment for 1 and 2½ months respectively with alfasol without effective evacuation

for a localized, but very deep empyema which required rib resection, suction drainage and a stay in hospital of two and three months respectively. In the first case (No. 5) the closed method was presumably the cause of the broncho-pleural fistula because of continued retention in the cavity, whereas the fistula in the other case (No. 6) was no doubt due to the original pulmonary abscess. In this old and frail patient the disease was complicated by a putrid, extensive phlegmon of the chest-wall.

In three cases a minor thoracoplasty was required. Two of these cases will be reported now, the third one (No. 16) a little later.

*Case 7.* Female, aged 25 (387/44, 27/46). Pneumonia on May 15, 1944. Entered a medical department on May 17. Two weeks later a diagnosis was made of an empyema, treated from June 3 to June 28 with six thoracocenteses and intrapleural injection of 35—50 cc. of alfasol, 40 per cent. From the middle of June a certain amount of purulent expectorate. On June 30 rib resection in a surgical department. The empyema cavity reached as far as the 1st rib in the axilla, but not farther basal than a hand's breadth above the diaphragm. Suction drainage for a week, then open drainage for three weeks prior to transference to the Clinic of Thoracic Surgery on July 30 because of the persistence of the cavity. There was a broncho-pleural fistula, but a mild suction could be maintained. This form of treatment was continued for almost two months. Upon discharge on Sept. 30 there was still a small empyema cavity (about 10 cm.) with a bronchial fistula. The pleuro-cutaneous fistula closed later, but instead a periodical purulent expectoration supervened in three months. X-ray still showed a quite narrow cloudy area at the site of the empyema in the axilla. Re-admitted on Jan. 3, 1946 for operation. Two days later a small thoracoplasty was performed, removing 30 cm. of the 3rd to 6th rib in the axilla. Discharged on Feb. 5 with a healed wound. Follow-up on Aug. 18, 1946: Symptomless.

*Case 8.* Male, aged 66 (188/46). On Jan. 15, 1946 suddenly symptoms resembling those of pneumonia without previous illness. Admitted to a medical department on Feb. 2, but transferred to a surgical department on Feb. 4 because of an empyema. Thoracocentesis 6 times with injection of alfasol (10—60 cc., 40 per cent.) until March 12 when a drainage by the method of BÜLAU was established. The drain was removed on March 28. From April 11 again thoracocenteses with injection of alfasol (three times, 20—30 cc., 40 per cent.) and penicillin (once, 40,000 units) until May 2. On May 4 perforation to the surface. The drain was then re-inserted, but fell out on May 20. The temperature rose and a profuse expectorate supervened, but no pus could be found on puncture. Transferred in a state of great debility to the Clinic of Thoracic Surgery on June 11. Immediate rib resection. An extremely irregular cavity, as large as an orange, with

thick pus (pneumococci type 10 and Pfeiffer's bacilli). Drainage was difficult because of the irregular shape of the cavity. For this reason a broad incision was made on June 19 and thoracoplasty by the method of ROBERTS with resection of 40 cm. of the 7th—10th rib. Blood transfusion. Satisfactory healing of the cavity. The daily amount of sputum decreased from 200 cc. to 40—50 cc. X-ray showed a persisting cloudiness of the lower lung field, resembling lower lobe atelectasis. Bronchoscopy revealed a stenotic tumour in the lower lobe bronchus. (Mier. exam.: solid bronchogenic carcinoma.) Carina broad and fixed. Considered inoperable. Discharged on Aug. 2 with a small, superficial granulating wound which had healed on Aug. 30.

The first one of these two patients (No. 7) had been treated with punctures for almost 4 weeks. During this period a bronchial fistula developed. The ineffective drainage and the lack of suction during the first month following rib resection have, however, in all probability contributed essentially to the protracted course and the necessity of a thoracoplasty. In the other case (No. 8) the bronchial carcinoma was presumably a contributory cause of the chronic course of the empyema, but the protracted treatment with punctures (5 months) and the incomplete evacuations have doubtless had their share. Retention in the empyema cavity has furthermore had the effect that the distinct X-ray signs of cancer were not detected after the drainage. It is not unreasonable to presume that the carcinoma could have been detected at an operable stage, if the empyema had been drained effectively at an earlier juncture.

Above the writer has reported some cases affected with broncho-pleural fistula (Nos. 4, 5, 7) arising during the aspiration treatment, probably on account of retention in the empyema. A pleuro-cutaneous fistula occurred for the same reason in an additional patient (No. 8). In two other cases the broncho-pleural fistula is probably due to a pre-existing causative lung disease (abscess). A broncho-pleural fistula had furthermore existed prior to the puncture treatment in two females (Nos. 8 and 10) aged 28 and 15 respectively, both transferred from a fever hospital for epidemic diseases (121/44, 141/46) following a brief local application of alfasol (No. 9, cf. KRIEGER LASSEN's Case history 10) and penicillin (No. 10) respectively. On admission to the Clinic of Thoracic Surgery the latter of these two patients (No. 10) had a phlegmon of the chest-wall (like Nos. 1, 2, and 6), arising from a hæmatoma in the intercostal space around one of the puncture canals. Apart from this the two case histories afford nothing special. The pa-

tients recovered following permanent drainage of 6—8 weeks' duration.

A broncho-pleural fistula arising in immediate connection with a puncture occurred in one case.

*Case 11.* Male, aged 28 (461/44). Taken ill on Aug. 27, 1944. Admitted to a fever hospital on Sept. 3 where infectious mononucleosis was diagnosed. On Sept. 8 pneumonia was diagnosed and on Sept. 21 empyema. Thoracocentesis yielding thin, putrid pus and an injection of alfasol. During the intervention cough, blood-tinged sputum and a bad taste in the mouth, later fetid expectoration. On Sept. 22 transferred to the Clinic of Thoracic Surgery where 4 thoracocenteses during the following week yielded gradually thicker pus (obligate anaerobic, Gram-positive, coryneiform rods). On Sept. 30 rib resection (closed method). Suction drainage. The bronchial fistula closed a few days later. Three weeks after the rib resection the empyema cavity was reduced to a narrow canal, 6—7 cm. in length, which later healed completely.

Now follows a case with extremely serious consequences, presumably resulting from an injury to the lung sustained during a puncture.

*Case 12.* Girl, aged 5 weeks (born on Oct. 1, 1945). (514/45.) At the age of 3 weeks (Oct. 23, 1945) admitted to a children's hospital for pneumonia. On the following day 35 cc. of thick pus was evacuated from the pleural cavity and 20,000 units of penicillin injected. Intramuscular injection of penicillin, 5,000—3,000 units 8 times daily. The injection of penicillin into the pleural cavity was repeated 4 times. In connection with the last injection increasing dyspnoea and cyanosis. On Oct. 30 a tension pneumothorax was ascertained. Gradually it was exacerbated and on Nov. 3 the patient was transferred to the Clinic of Thoracic Surgery. During the transport the patient required oxygen and on arrival her condition was alarming. Immediate intercostal pleurotomy yielding large quantities of air and some very clotted pus (*staphylococcus aureus*). During the following three days air kept flowing through the drain indicating that the pulmonary fistula persisted. Thereupon it appeared to have closed. Suction drainage. The lung remained expanded and on Nov. 10 it adhered to the chest-wall. After a temporary improvement, the patient again went downhill. The temperature remained normal. Died 18 days after admission. Post-mortem examination: The empyema cavity is quite narrow, mostly obliterated, covered with a certain amount of fibrin, but without retention of pus. The contralateral pleural cavity and the pericardium are the site of severe fibrinous precipitations, but there is no liquid effusion. No visible injury to the lungs.

The pulmonary fistula caused by the puncture was not the direct cause of death. On admission the condition was, however,

extremely dangerous, and had the transport to the Clinic of Thoracic Surgery been longer, death would presumably have occurred because of the tension pneumothorax. In all probability death was due to infection of both pleural cavities and the pericardium. The possibility cannot be ruled out that the consequences of this infection would have been less serious, if the original empyema had been drained more effectively instead of insufficiently aspirated during the two previous weeks.

In one case the local application of penicillin was performed through a BÜLAU drain.

*Case 13.* Male, aged 36 (500/45). For the last 10 years there had been slight purulent expectorate, particularly in the morning. On Sept. 15, 1945 suddenly symptoms of pneumonia and increased, purulent, non-fetid expectorate. On Sept. 24 admitted to a medical department. Pus was found in the left pleural cavity (streptococci), and the patient transferred on Sept. 30 to a surgical department where a pleurotomy by the method of BÜLAU was performed on the same day. This was followed by application of penicillin, 35,000 units, four times daily through the drainage tube. Transferred to the Clinic of Thoracic Surgery on Oct. 22 because of retention of pus in the cavity. Rib resection on Oct. 24. The empyema cavity was found to be as large as the hand of a man and filled with thick, extremely fibrinous pus. Suction drainage until Nov. 7. When the empyema had been drained, X-ray revealed a mesh-like pattern of the lung on the affected side. Bronchography revealed bronchiectases, of sizes up to a pea, in the lower lobe and in the lingula pulmonis. The patient had Hippocratic fingers. After the drainage the daily amount of sputum decreased from about 20 cc. to 1—5 cc. Discharged on Nov. 14 with a narrow fistula, 8 cm. deep, which healed during ambulatory treatment. The patient does not want to submit to treatment for the bronchiectasis.

Like No. 8 this case history illustrates the manner in which an empyema with retention may for a long time mask a pulmonary disease which is distinctly apparent on the X-ray film as soon as the empyema cavity has been drained. This fact was not, however, of any importance in this case -- in contradistinction to No. 8 — as the bronchiectases did not require any particular treatment anyhow. In this case far more interest attaches to the fact that local application of penicillin was unable to prevent the common difficulties of drainage arising during the later stages of BÜLAU drainage.

In two of the last cases of empyemas treated locally with penicillin or alfasol (Nos. 14, 115/45 and No. 15 173/46), the treatment had only been carried out for less than a week before ad-



mission to the Clinic of Thoracic Surgery and the course did not differ from the usual one of acute empyemas. In one of the cases (No. 15) the underlying disease was a pulmonary abscess, and the complicating empyema contained extremely putrid pus (no growth, but no cultivation was made for anaerobic organisms). Following three injections of penicillin (a total of 140,000 units) the pus was only slightly foul-smelling.

Considerable diagnostic difficulties were experienced in the following case whose very long history will be reported as the last one in this series:

*Case 16.* Male, aged 46 (462/45). Hæmothorax following a gunshot through the left thorax (hand weapon) during the fighting around the Royal Palace on September 19, 1944. Immediately admitted to a surgical department. Thoracocenteses and later — when the effusion grew purulent — also six injections of penicillin (a total of 90 000 units) into the pleural cavity. During part of this period the patient brought up large quantities of purulent sputum. Discharged on Nov. 24. Thereupon apparent recovery. More than 7 months later fever up to 40° C. with chills and pain in the basal part of the left thorax and in the left flank. Entered a medical department on July 21, 1945. X-ray revealed a cloudy area, mostly paravertebral, in the basal and posterior part of the left pleural cavity. Transferred to the Clinic of Thoracic Surgery on Aug. 10. X-ray aspect unchanged, bronchography revealed normal conditions apart from lacking filling of the small cloudy paravertebral area which was interpreted as a thickening of the pleura resulting from the empyema, as trial puncture at several sites had yielded nothing. Five weeks were spent in observation and examination of numerous other organs. Twice the temperature rose to 38.2° C. The blood sedimentation rate was greatly enhanced all the time (135—32—115—96), the leukocyte count moderately increased (12,040—12,460—10,400). For the first time in 9 months there was some expectorate on Sept. 10 (purulent lumps with pneumococci of type 9). The amount of the sputum gradually increased. A trial puncture on Sept. 17 yielded some pus. On Sept. 18 thoracoplasty by the method of ROBERTS revealing in the immediate vicinity of the scar resulting from the wound of exit a paravertebral, vertical, cylindrical, smooth-walled empyema cavity, somewhat larger than a thumb, containing some pus (*staphylococcus aureus*) with a bronchial fistula at the bottom. A total of 26 cm. was resected off the 8th—10th rib. Following operation the daily amount of sputum gradually decreased from 40 cc. to 0 cc. in the course of 9 days. Discharged on Oct. 8 without signs of bronchial fistula. During a month's course of ambulatory treatment the wound healed completely.

For 7 months this patient had been considered cured, subjectively as well as objectively, by the local application of penicillin.

Then vague symptoms set in. The cause of these symptoms was only detected after three months of illness, of which more than one month was spent in the Clinic of Thoracic Surgery. The secondary illness including operation and temporary disablement took 5 months in all. Probably one cannot rule out the possibility that the course might have been the same following drainage of the original empyema, but the risk must be greater following puncture than drainage. The fact that the purulent expectorate did not set in until the puncture treatment of the empyema was started and did not exist previously, strongly suggests that it was retention in the empyema which constituted the main cause of the chronic broncho-pleural fistula. The gunshot wound has probably been of minor importance although likely to be a predisposing factor by having formed a place of least resistance in the lung.

### Survey of the Drawbacks of the Therapy.

Collecting the untoward results of the puncture treatment in the 16 cases reported above and supplementing them with information obtained from the literature, the writer has summarized them in the following table:

#### Survey of the Drawbacks of the Local Application of Chemotherapeutic and Antibiotic Agents to Pleural Empyema.

(The figures in brackets indicate the cases histories reported above.)

##### *A. Drawbacks attaching to the puncture proper.*

- 1) Injury to the lung.
  - a) Hæmorrhage (5?).
  - b) Broncho-pleural fistula (11).
  - c) Valvular pneumothorax (12).
  - d) Air embolism.
- 2) Injury to the chest-wall.
  - a) Injury to intercostal blood vessel (5?, 10).
  - b) Phlegmon of the chest-wall (1, 2, 6, 10).
- 3) Injury to other organs and tissues.
- 4) Pain at the punctures.

*B. Drawbacks attaching to the incomplete aspiration of pus.*

- 1) Compression of the lung.
  - a) A (nearly) total empyema of long standing (1, 2, 3, 4).
  - b) A large and very deep empyema of long standing (5, 6).
  - c) Chronic, minor empyema requiring thoracoplasty (7, 8, 16).
  - d) Maintenance of a primary broncho-pleural fistula (6, 9).
  - e) Chronic changes of the lung parenchyma.
- 2) Perforation of the pus to the surrounding tissues.
  - a) Broncho-pleural fistula (4, 5, 7, 11, 16).
  - b) Pleurocutaneous fistula (8).
- 3) Persisting general infection or intoxication.
  - a) Debilitation of the general condition.
  - b) Death (12).
- 4) The causative disease may be overlooked.
  - a) Pulmonary abscess (1).
  - b) Bronchial carcinoma (8).
  - c) Bronchiectasis (13).
- 5) Formation of an empyema cavity of an atypical site (5, 7).

*C. Drawbacks attaching to the drugs injected into the pleural cavity*

- 1) Local
  - a) Microbial chemoresistance.
  - b) Irritation of pleura, injury to tissues.
  - c) Formation of large fibrinous masses, perhaps requiring major thoracotomy.
- 2) Universal
 

Masking of the symptoms by a phlegmon of the chest-wall etc.

The drawbacks enumerated under A attach to any puncture of the pleural cavity (36) and no patient suffering from empyema is spared the risk, as a diagnostic puncture is at any rate always performed, as a rule also a therapeutic puncture for the aspiration of the quite fresh empyema contents. But of course the risk increases with the number of punctures, *i. e.* the length of time the puncture treatment is continued. According to ARNESEN (3) hæmorrhage in the empyema cavity may be caused by the marked negative pressure left by powerful aspiration and it need not be due to an injury to the lung or intercostal blood vessels produced

by the cannula. The reason why the hæmorrhage in Case 5 has been interpreted as a result of injury is that the presence of the broncho-pleural fistula must have prevented a marked negative pressure. *Air embolism* did not occur in the writer's material, but ARNESEN reports a case (case history 1) in which death occurred in connection with the fourth puncture.

*Phlegmons of the chest-wall* deserve particular attention. All four cases in the writer's material occurred among the 7 patients (Nos. 1, 2, 6, 9, 10, 11, 15) with putrid empyema. Three of the cases exhibited serious phlegmons requiring large incisions, whereas a smaller incision in connection with local and universal application of penicillin cured the fourth. (It should be mentioned that in a few of the other phlegmons an immediate, favourable effect has been observed following local application of penicillin or alfasol, not least as regards removing the putridity.) Often such phlegmons are insidious, being of a deep situation, reaching as far as the ribs and covered with the large muscles of the back and chest. In such a site they may become very large before they are diagnosed. (In merely one case had the phlegmon been detected prior to admission to the Clinic of Thoracic Surgery). There is hardly any doubt that the phlegmons are caused by the punctures, as their intensity and depth is greatest at the sites of the punctures. In every case the same microbes could be cultivated from the phlegmon and the empyema (except in No. 1 where no microbes were demonstrable). According to observations made by the writer at thoracocenteses through artificially established funnel-shaped wounds leading to the intercostal space the cause of the phlegmons is rather a direct escape of pus through the puncture hole to the thickened, inelastic pleura and the permeable intercostal musculature than microbes drawn out with the cannula. The insidious development of these phlegmons is perhaps partly a result of the application of sulfonamide or penicillin which in this as well as other sites may greatly mask the classical syndromes. Even though the substances in question have only been applied intrapleurally, their effect may be universal on account of absorption from the pleural cavity.

*The pain* felt at the punctures is a factor which must not be neglected. Often the psyche of the empyema patients is strangely sensitive. Men who have been sturdy prior to their disease become susceptible and tearful. It is a fact that even a carefully administered local anæsthesia is often insufficient if puncture, aspira-

tion, measurement of the pressure and perhaps irrigation and injection are to be carried out with thoroughness. Often the entreaties of the patients can move the surgeon to carry out the puncture treatment less often and less thoroughly than it has been his intention, and this becomes more marked the longer the treatment is continued. On admission to the Clinic of Thoracic Surgery many patients have welcomed the thought of escaping the punctures, even at the cost of having to substitute them with a drain.

*Valvular pneumothorax* is without a doubt a rare complication, but an extremely dangerous one, not least in cases of empyema, as the cavity will be enlarged by the increased pressure. This bursts fresh demarcating adhesions and synechiae, the empyema may become total, the absorption increases, an old pneumonia may flare up, and circulatory collapse or rapid suffocation may result.

The most common and most serious disadvantages of the puncture treatment are, however, due to deficient evacuation of the empyema contents, *i. e.* caused by *retention of pus* in the cavity. The fundamental rule of any treatment of empyema, effective evacuation of the pus, still applies, no matter what kind of therapy is employed. This rule can be complied with for a limited period by energetic punctures and aspirations, if the treatment is in the hands of a trained, energetic and enthusiastic therapist, as apparent for instance from the results obtained by ARNESEN (3) and from KRIEGER LASSEN'S (34) and HEUER'S (26) reviews of the literature. But in the majority of cases it will be impossible to remove the gradually thickening pus through a cannula.

It is true that the pus has sometimes been observed to grow thinner during local application of sulfonamides and penicillin, and in such cases the punctures can be continued. In others, and probably in most cases, the reverse will, however, be the case, and it is particularly the enormous masses of precipitated fibrin that prevent effective aspiration through a cannula.

The material submitted by the writer comprises 6 cases of very large empyemas which persisted for a month or longer in spite of puncture treatment. This is an evidence that the fundamental rule of thorough evacuation of the pus has been neglected. The roentgenograms left no doubt of the presence of retention: in 4 of the cases there was cloudiness of the total area and displacement of the *mediastinum* towards the healthy side, and in 2 the lung was compressed to the hilus by a large, demarcated effusion.

Retention of pus in the empyema cavity primarily causes compression of the lung so that re-expansion will be difficult or impossible after the evacuation of the pus. *Suction drainage must therefore be continued considerably longer than normally, thoracoplasty may become inevitable, and there may ensue chronic changes of the lung parenchyma* consisting of fibrosis and bronchiectases which are only tractable by major operations which do not even give more than a doubtful prognosis.

Retention of pus may cause *perforation from the empyema to the skin or to a bronchus*. Furthermore, it may maintain a *primary bronchopleural fistula* which is encountered in some cases of empyema because of the perforation of a pulmonary abscess into the pleural space.

In the majority of the cases now submitted the local application of alfasol or penicillin has failed to sterilize the empyemas completely. And even if it has succeeded, the empyema has not been cured (cf. Nos. 10 and 16). *A sterile empyema is not a cured empyema*; it still compresses the lung, it may force its way through a bronchus and it may become secondarily infected by the canalicular route, by the lymph or the blood stream.

Moreover, the reported case histories demonstrate how an empyema with retention may *mask a causative disease* for a long time: pulmonary abscess (No. 1), bronchial carcinoma (No. 8), bronchiectasis (No. 13) etc. In children the risk of aspirated foreign bodies must always be kept in mind.

A drawback of the puncture treatment of empyemas with local application of sulfonamide and penicillin which has not caused much inconvenience in the writer's material (cf., however, Nos. 5 and 7) but which is common according to the literature is the *formation of empyema cavities of an atypical site* (apical, paravertebral, mediastinal etc.). Such cavities are more difficult to treat than the typical basal and lateral ones. Their occurrence is quite easily explicable: While the empyema is large a small cavity is walled off at a distance from the sites of puncture. It remains latent while the large cavity is being treated and perhaps cured, and then it starts giving symptoms. Following universal chemotherapy too atypical empyemas appear to be more common than earlier (10, 32, 38).

Another disadvantage in connection with the injection of chemotherapeutic and antibiotic agents into a serous cavity like

the pleural space is the *irritative capacity* of these drugs. This is, however, a drawback which has not received much attention. During the first years of this therapy the sulfonamides used were only soluble in strongly alkaline media. In that case such injections will of course cause great damage to the tissues. The preparations used in Scandinavia by KRIEGER LASSEN (34) and BRUCE et al. (9), alfasol and lucosil, are, however, marketed in neutral solutions and are therefore of a far less irritative effect. Solutions of penicillin may also have a certain irritative capacity as demonstrated by TILLET et al. (49) who found leukocytic reaction, elevation of temperature and pain following injection of even small quantities of the substance into serous pleural effusions and transudates. According to a personal communication from TILLET, it is, however, possible that the penicillin used at that time may have contained impurities which are no longer present in the substance.

### Precautionary Measures Against the Drawbacks of Local Treatment.

*Injury to the lung tissue* can only be avoided by careful puncture following determination of the most suitable site of puncture by conscientious stethoscopy and good roentgenograms in two or more views. It is an old-established rule that the puncture shall always be performed along the upper edge of a rib, but it is not always sufficient to prevent injury to an intercostal vessel. The patient may be bending over to the affected side so that the ribs are close together and therefore an intercostal vessel may be injured in spite of all. Therefore the patient should be instructed to bend to the opposite side.

The *phlegmons* which are so common in cases of putrid empyemas can be avoided by excising the puncture canal after the first puncture as far as the intercostal musculature and forming a funnel-shaped wound which should be plugged with a tampon of iodoform gauze or the like. This will soon afford a path for future punctures which is covered with granulations and resistant to infection (MORRISTON DAVIES & COOPE (42), p. 75). A further advantage of this method is the facilitation of administering effective local anæsthesia.

*Pain* felt at the punctures can be most easily avoided by employing universal anæsthesia, preferably intravenous. This

method has been used a great deal in war surgery for the treatment of hæmothorax (MORRISTON DAVIES & COOPE, p. 64). Profuse purulent sputum is, however, a contra-indication to deep and protracted sleep.

*Effective evacuation* of the pus is performed by frequent, perhaps daily, and thorough aspirations, the effect of which should be controlled carefully each time by stethoseopy and good roentgenograms in two (or more) views. It should be emphasized that small foci of pus cannot be visualized on the X-ray film. As a rule it must be a condition that each puncture is followed by a fall in temperature, and in the course of a short period (one to two weeks at the utmost) the temperature should be normal. This applies to treatment of empyemas by puncture as well as by drainage. In certain cases an empyema patient may have a normal temperature in spite of retention of pus. The observation must therefore comprise a careful estimation of the general condition with a view to intoxication, blood sedimentation rate, hæmoglobin percentage etc. In patients who have had no expectoration previously, a correct treatment of empyema ought to lead to the rapid cessation of the expectoration.

During the aspirations it is often necessary and beneficial to insufflate air. "A thoracocentesis should always . . . be a pneumothoracocentesis" (TÖRNING (50), p. 164). But the quantity of air insufflated must be smaller than the quantity of pus evacuated. Otherwise the size of the cavity will increase and a fresh synechia burst. Irrigation of the cavity is often useful (ARNESEN (3), BRUCE et al. (9)), but the same precautions must be considered and no pressure should be employed. In case ehloramine is used it must be washed out with ample saline solution, before the injection of penicillin. If not, the penicillin will be destroyed immediately. If the cavity is not irrigated, there is a risk that the penicillin does not reach all recesses of the cavity or that the effect of the alfasol is inhibited by antisulfonamides. If the puncture causes difficulties, it may with benefit be conducted under the fluoroscopic screen. As yet it does not appear to have been decided whether the chemotherapeutic and antibiotic agents should be injected in a concentrated form in a rather small amount of medium or diluted in larger amounts of fluid, but providing an effective evacuation of the pus, the latter appears to be most rational. As the empyema grows small, one must, however, be careful that the solution is not injected in too large quantities.



It goes without saying that the drugs injected must have an effect on the microbes in question. *A determination of the resistance* must therefore be conducted as a matter of routine like cultivation for tubercle bacilli in any case of empyema. Repeated microscopical examinations and cultivations to ascertain the reduction and gradual disappearance of the microbes are valuable, but by no means solely decisive for the effect of the treatment. It must be borne in mind that novocaine etc. are antisulfonamides (44). Intrapleural injection must therefore be avoided when the local anaesthesia is to be administered.

### Summary.

In the local treatment of empyema early and frequent punctures, aspiration of the pus, and intrapleural injection of chemotherapeutic and antibiotic agents in large doses are of great value during the first stage of the disease. In non-tuberculous cases this treatment should, however, be replaced by permanent drainage, if freedom from symptoms is not obtained quickly, including a clear thoracic field and a fully expanded lung on the X-ray film. It depends to a great extent on the care and thoroughness with which the treatment is carried out how long puncture treatment is sufficient and in which cases a drain has to be inserted. There is hardly any doubt that a few specially trained and enthusiastic therapists are capable of curing a considerable number of empyema patients by the puncture method alone.

This form of therapy is, however, particularly exacting, and during the later stages of empyema it must be considered far more difficult than drainage. Moreover, it entails no small risk. It must therefore be considered *a fact that during the later stages of empyema, permanent drainage affords the best chances of a cure. One runs a greater risk in leaving even sterile pus and fibrin in the pleural cavity than in establishing a drainage.* Thanks to the local treatment operation can now as a rule be put off to a time when it practically speaking involves no risk.

In tuberculous empyemas of the mixed infection type it is of course advisable to prolong the course of punctures and injections as much as possible.

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## **Hyperthermia in Association with Shock.<sup>1</sup>**

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Ever since 1922 postoperative hyperthermia in infants has, through OMBRÉDANNE's works, been generally acknowledged as an independent, well-characterized syndrome. Otherwise with hyperthermia in adults. There has been a general tendency to explain these sudden, puzzling, and feared rises in temperature shortly after great operations as caused by fulminant infections, cerebral affections, liver damages, etc. However, reports from the past ten years, notably from France, seem suggestive of a more extensive acknowledgement of the existence of the syndrome, also in adults, as a specific postoperative condition. It is still only with regard to the delimitation of the syndrome on a purely clinical basis that there is a certain agreement. Opinions are divided with regard to pathogenesis, treatment, and prognosis. A novel point of view concerning the pathogenesis of certain forms of postoperative hyperthermia in adults will, therefore, be advanced and accounted for in the present paper.

### **First Case Observed of Hyperthermia in Association with Postoperative Shock.**

*Case I* (981/1944). A man, aged 29, had for two years had a tuberculous cavity the size of a hen's egg in the left upper lobe. Temperature normal for at least nine months. No demonstrable endocrine or neurological disease. March 30, 1944: first stage of thoracoplasty with

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<sup>1</sup> Read before the Danish Society of Surgery on December 2, 1944.

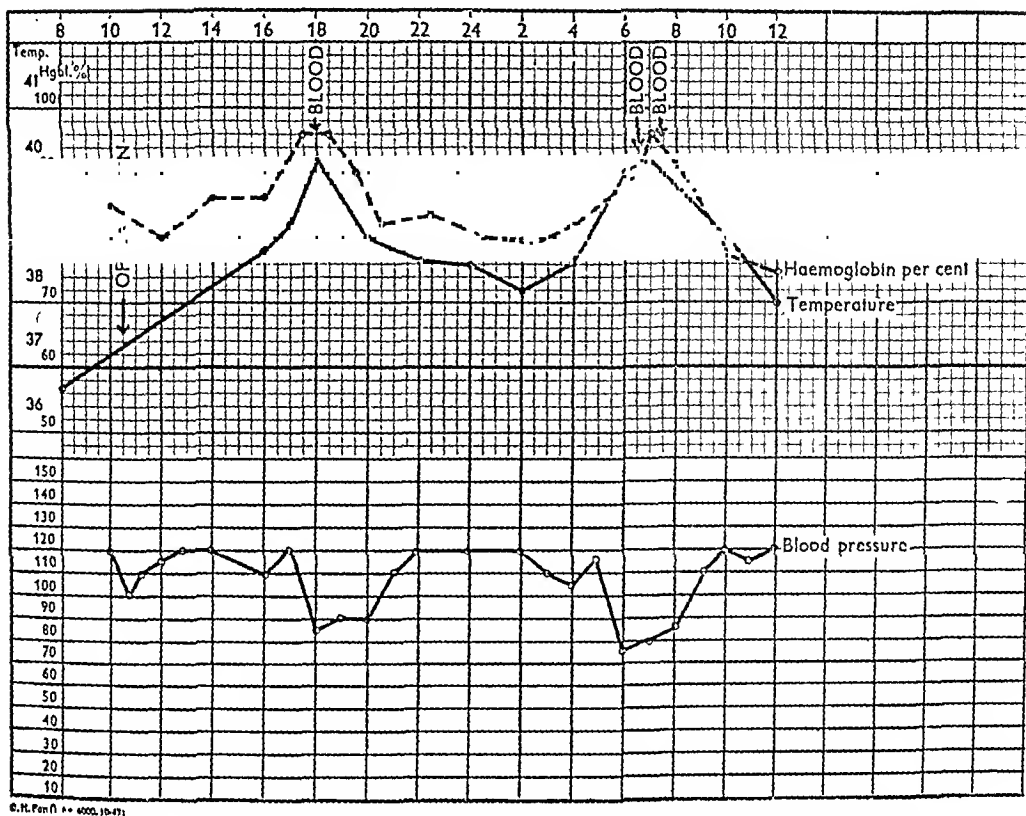


Fig. 1. Case I. Shock and hyperthermia twice after third stage of thoracoplasty for pulmonary tuberculosis. Recovery after blood transfusions.

removal of 1st to 4th ribs and apicolysis. Seven hours later the patient was pale, cool, and perspiring with a small and soft pulse of 140. Blood pressure 90, falling. Rectal temperature  $40.4^{\circ}\text{C}$  ( $104.8^{\circ}\text{F}$ ). After blood transfusion (500 c.cm.) the skin became normal of colour and temperature, and the perspiration ceased. Pulse rate 104. Blood pressure 115. The rectal temperature fell within twelve hours to  $38.1^{\circ}\text{C}$  ( $100.6^{\circ}\text{F}$ ). The second stage passed off without complications. On April 27, 1944 the third and last stage of the operation was performed with resection of 7th to 9th ribs. This operation was followed by shock and hyperthermia twice, after six and twenty-two hours respectively. Blood transfusions (500 and 1000 c.cm.) again had a prompt effect (Fig. 1). Further course uneventful. There occurred no clinical nor radiologically demonstrable signs of spreading of the pulmonary process, and the patient presented neither psychic nor neurologic symptoms. The cavity soon closed, and sputum as well as gastric lavage became free from bacilli.

Haemoglobin, blood pressure, and rectal temperature were determined every hour after the last operation. The results appear from Fig. 1. There was a close parallelism between the development of shock and the rise in temperature. The temperature fell promptly after the treatment of the shock.

## Rectal Temperature in Postoperative Shock.

Since DEMARQUAY'S and REDARD'S investigations shock has generally been stated to be associated with a subnormal body temperature. Recent investigations have shown, however, that shock may also be attended by fever (CHIEVITZ p. 72, KOSTER p. 64).

The present investigation extended over a period of four months, within which the rectal temperature was measured every hour for the first 24 hours after all operations of any size. Twelve out of twenty patients with typical manifest shock revealed no characteristic fluctuations, while there was hypothermia from 37.2°C (99.0°F) to 35.4°C (95.8°F) in one case and hyperthermia in seven. The data of the latter appear from Table 1, which includes also the three shock-hyperthermia attacks of case I (Nos. 1 to 3) and a case of shock and hyperthermia after a gunshot wound (No. 11).

Table 1.

*Cases of Postoperative Shock with Increased Rectal Temperature.*

No.	Case Record	Sex	Age	Disease	Operation	Maximal rectal temperature	Hours after operation	Treatment	Remarks
1	I	M	29	Pulm. tuberc.	Th. plasty I	40.4	7	Blood	
2	I	M	29	"	" III	40.2	6	Blood	
3	I	M	29	"	" III	40.2	22	Blood	
4		M	30	"	" I	39.1	4	Serum	Died
5	II	M	35	"	" III	39.8	10	Serum	
6	III	F	24	" +ac. append.	Appendicectomy	39.1	3	+Blood Blood	Died
7		F	30	Tub. empyema	Th. plasty II	40.5	7	Serum	
8		M	39	Pulm. tuberc.	" I	39.6	5	Blood	
9		M	43	Chr. empyema	" I	39.6	4	Blood	
10		F	36	Pulm. tuberc.	" II	39.3	8	Blood	
11	IV	M	18	Gunshot wound of thorax		39.5	4	Plasm +Blood	

These previously afebrile patients (only No. 6, case III, was feverish beforehand) developed in the course of from three to ten hours a rise in the rectal temperature generally to between 39° and 40°C (102° and 104°F). The fever reached its maximum by the time the shock was most pronounced. There were no signs of an infectious cause. In seven of the cases (Nos. 4 to 7 and 9 to 11)

blood samples were taken from one to three times during the temperature rise; but bacterial growth was demonstrated in none of these cases. The further course revealed no infection either; neither did the postmortem examination of the two patients who died.

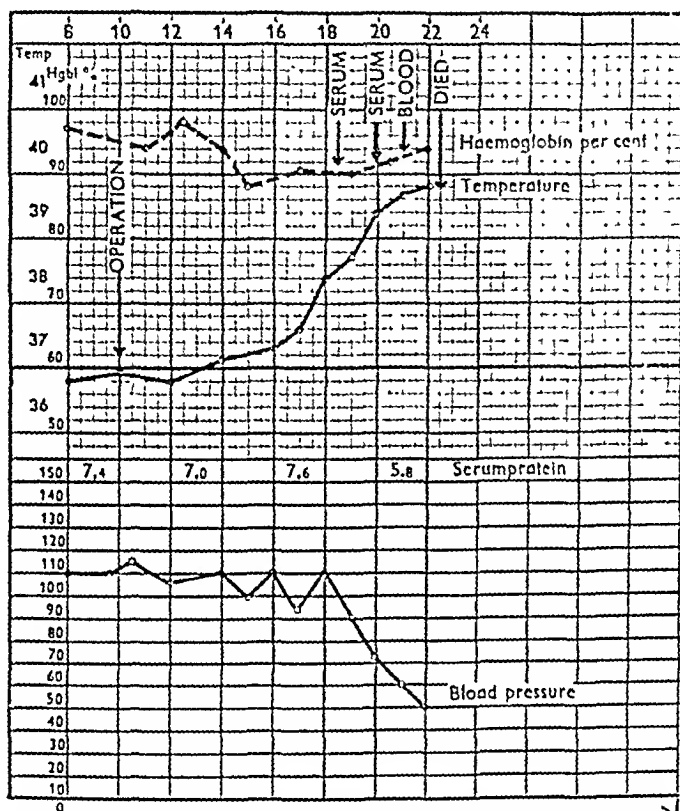


Fig. 2. Case II. Shock and hyperthermia after third stage of thoracoplasty for pulmonary tuberculosis. Fatal course despite transfusions of serum and blood.

After successful treatment of the shock the temperature always fell at the same rate at which it rose, most often from  $\frac{1}{4}$  to  $\frac{1}{2}$  degree Celsius per hour. Instances of the temperature curves are given in Figs. I to IV.

In two cases the state of shock persisted despite treatment and the rectal temperature remained high until death.

*Case II* (No. 5 in Table 1, 834/1944). A man, aged 35, with fibrocavernous phthisis developed a severe shock with a temperature of  $38.4^{\circ}\text{C}$  ( $101.2^{\circ}\text{F}$ ) after the third stage of thoracoplasty. The shock persisted despite serum (1000 c.cm.) and blood (500) as well as oxygen, and the temperature rose further to  $39.5^{\circ}\text{C}$  ( $103.6^{\circ}\text{F}$ ) (Fig. 2). Death occurred eleven hours after the operation. The postmortem examination revealed nothing of particular interest.

The other fatal case resembled the one just reported, only death occurred here already after four hours (No. 4 in Table 1, 919/1944). There were no signs of primary anoxaemia.

Also a minor laparotomy has given shock with attending rise in temperature.

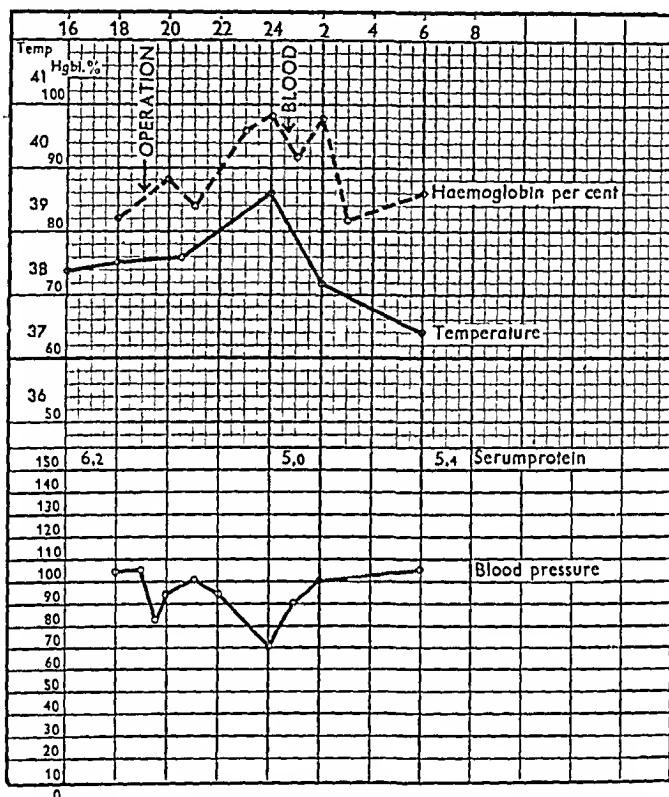


Fig. 3. Case III. Shock and temperature rise after appendicectomy. Recovery after blood transfusion.

*Case III* (No. 6 in Table 1, 1090/1944). A woman, aged 24, was operated on for acute appendicitis without peritonitis three weeks after seven ribs' thoracoplasty for tuberculosis. The operation was performed in spinal anaesthesia. A shock was ascertained four hours later. The rectal temperature rose from 38.6°C (101.5°F) to 39.6°C (103.3°F). The shock subsided after blood transfusion, and the temperature promptly fell (Fig. 3).

Finally a case will be reported of gunshot lesion of the thorax.

*Case IV* (No. 11 in Table 1, 6/1946). A man, aged 18, was hit by a 9 mm. carbine projectile fired from close quarters. Was admitted with open pneumo-haemothorax, which was treated by air-tight dressing, exsufflation, thoracentesis, and suturing. A dry plasma solution (500 c.cm.) was injected and blood transfusion (1500 c.cm.) was



given because of shock and fever. The shock subsided and the temperature fell (Fig. 4).

It has thus been demonstrated that shock may be attended by an abrupt and considerable rise in the body temperature. The temperature promptly falls after successful treatment of the shock.

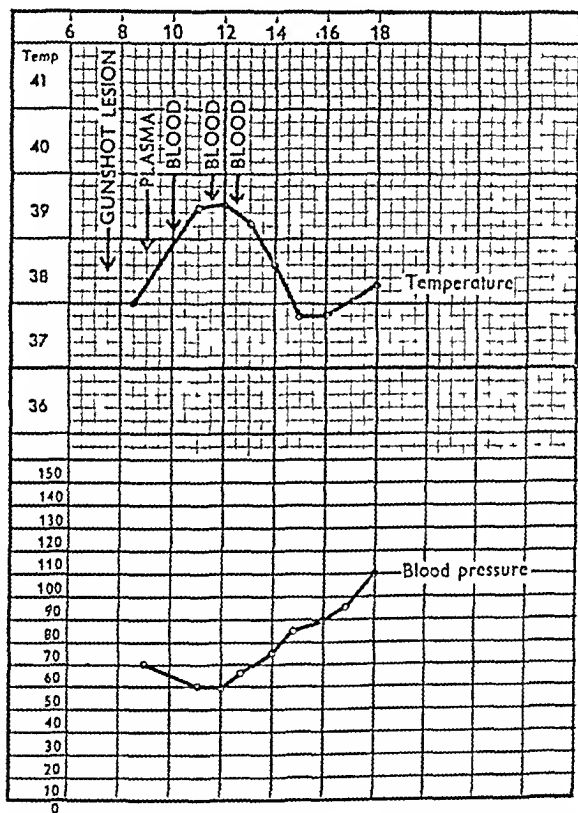


Fig. 4. Case IV. Shock and temperature rise after gunshot lesion with open haemo-pneumothorax. Recovery after blood transfusions.

If the shock does not respond to treatment the hyperthermia will persist.

A characteristic and important clinical feature is the complete absence of shivering fits during the abrupt rise in the temperature of shock patients. Equally characteristic is the fact that the fall in temperature occurs (almost) without perspiration. On the contrary the shock perspiration ceases and the skin becomes warm and dry during the defervescence.

Characteristic is also the comparatively late occurrence or recognition of the shock in the cases attended by hyperthermia.

Most often the interval between operation and shock was two or three times longer in these cases than in the others treated by blood transfusion after the operation.

## Postoperative Hyperthermia in Adults.

### *Retrospective Analysis.*

The first reports on postoperative hyperthermia as an independent syndrome in adults are no doubt due to ALAJOUANINE & QUÉNY and HUSTIN (both 1937). Various casuistic reports have been published since. The condition is no rarity. HOUGAARD & ISEN found 76 fatal cases between 1920 and 1938 in the State Hospital, Sønderborg, where about 1,500 (indeed, chiefly severe) surgical cases were treated every year. This means about four per year or 5 to 10 % of the total number of deaths. Half of the 76 cases were »pure», by which ISEN understands fatal cases with a temperature rise to 40°C (104°F) or more within 24 hours after the operation in previously afebrile patients, without any other clinical or autoptic cause than the operation itself being demonstrable. (Cases of thyrotoxic crisis must, of course, be excluded from those collected on the basis of this definition, since both clinical signs and pathogenesis place them in an independent group.) Gastric operations are particularly often followed by hyperthermia. Thus, GREGERSEN found that among 24 fatal cases of gastric resection for cancer 17 (71 %) ran "a rather characteristic course with a promptly occurring rise in temperature to 40°C or more, and death after a few days. Nothing else has been observed" (particularly not on postmortem examinations). HANSEN, BOEHM, RASMUSSEN & RATJEN registered among 71 deaths after gastric operation for chronic ulcer 16 which were due to hyperthermia (22.6 %) against 8 (11.3 %) caused by recognized (treated) shock.

The clinical picture of postoperative hyperthermia will be figured on the basis of a number of cases from the literature supplemented by the cases observed before 1944 by the author in person. They have been entered in Table 2.

Unlike infant hyperthermia that seen in adults occurs almost exclusively after fairly great operations in prolonged general anaesthesia. The hyperthermia is generally observed within 24 hours after the operation. The rate of the temperature rise varies,

Table 2.

*Cases of Postoperative Hyperthermia from the Literature Together with Own Cases up to 1944.*

No.	Author	Year	Sex	Age	Operation	Re- marks
1	QUÉNY	1937	F	17	Excision of occipital aneurism	Died
2	MONDOR	1937	M	13	Appendicectomy	
3	LEVEUR	1937	F	55	Excision of uterine neck	Died
4	HUSTIN	1937	M	56	Gastrectomy (ulcer)	Died
5	GOSSET	1941	M	52	Ventral Herniotomy	
6	"	1941	M	44	Laparotomy with adhesion separation	
7	SOUPAULT	1941	M	43	Gastrectomy (ulcer)	
8	"	1941	M	53	Gastrectomy (ulcer)	
9	BOU- DREUX	1943	F	36	Bloody reposition of elbow fracture	Died
10	Own case	1938	M	21	Gastrectomy (perforated ulcer)	Died
11	"	1939	M	58	Gastrectomy (cancer)	Died
12	"	1939	M	49	Gastrectomy (ulcer)	Died
13	"	1940	F	62	Salpingo-oophorectomy (cancer)	Died
14	"	1941	F	40	Cholecystectomy, choledochotomy	Died

but  $40^{\circ}\text{C}$  ( $104^{\circ}\text{F}$ ) is most often attained within 6 to 12 hours. There are no shivering fits nor sensation of cold. The temperature remains high until death occurs not later than after a few days, sometimes preceded by small convulsions. More rarely the condition improves with a fall in the temperature to normal postoperative values in the course of from a few to about twelve hours. During the state of hyperthermia the patients are greyish pale and sometimes slightly cyanotic. The skin of forehead and extremities, and in the end also that of the body, is most often cold and perspiring. The pulse is small and quick, gradually becoming filiform and uncountable. The blood pressure is normal at first, but later it falls to between 70 and 80, to become immeasurable at last. The urinary output is small. Consciousness is long preserved, but the patients are remote, drowsy, and faint. Autopsies have never revealed any definite causes of fever and death. Examinations with a view to a possible haemoconcentration or hypoproteinaemia seem no more than blood cultivations to have been undertaken so far.

Patho-anatomically the changes in the central nervous system have been of the greatest interest. There are found (ALAJOUANINE & QUÉNY) oedema of the cerebrum, vasodilatation, stasis, and dilatation of the perivascular spaces, which are filled with fibrin; moreover, serous soaking of the nervous tissue and pericellular oedema. The changes are most pronounced in the brain stem, and

about the tuber cinereum and the basal ganglia; less so in the cortex.

The clinical picture of the above condition bears a considerable resemblance to the so-called high-temperature liver death syndrome studied particularly in the U. S. A.: shortly after liver and bile duct operations there may occur a rise in temperature to over 40°C (104°F), quick pulse, falling blood pressure, circulation collapse, coma, and death in the course of 36 to 48 hours. The histological changes in this condition consist (HEYD and BOYCE) in passive hyperaemia, oedema, and focal necrosis of the liver tissue. A similar histological picture has been brought about experimentally by ligature of the hepatic artery or some of its branches (v. HABERER, LOEFFLER, and SUTTON, a). Accidental lesion of the artery during bile duct operations has, therefore, been regarded as the cause of the pathological picture (HENSCHEN).

The pathological picture in question can, however, by no means always be explained as due to a lesion of the hepatic artery. SUTTON (b) admits that it may be found in association with burns, ileus, etc. But he declares that the liver changes described, *i. e.* oedema and necrosis, are present also in these cases, and he takes them always to be the cause of the pathological picture.

Liver changes do not seem to have been mentioned in literature in the cases described as postoperative hyperthermia. In the author's own cases the gross examination of the liver revealed nothing abnormal. No histological examination was made.

### Comparison Between the Signs and Symptoms in Postoperative Shock and Hyperthermia.

The signs and symptoms in hyperthermia, as indicated in the preceding section, will now be compared with those of shock. First the patho-anatomical: Liver changes, such as hyperaemia, oedema, and organ degeneration have been ascertained in shock just as well as in the high-temperature liver death syndrome (DUNPHY, GIBSON & KEELEY). ÅKERRÉN even regards liver changes of this type as so pathognomonic of shock that, when ascertaining their presence in prematurely born babies who die shortly after birth, he takes the cause of death to be shock. MUIRHEAD, KREGEL & HILL have demonstrated necroses in the liver in protracted experimental shock in addition to the signs already described. This

finding accords with BOYCE's demonstration of the fact that the histological liver changes are the more pronounced the longer the patients live after the operation. Accordingly the liver changes seem hardly to be the primary causes of postoperative hyperthermia, but must rather be supposed to be a consequence of the post-operative protracted shock.

The results are less clear with regard to the histological brain changes; but oedema, notably of the brain stem, as well as lesions of the basal ganglia are the most frequent findings both in shock and in hyperthermia, no matter whether the latter is of the post-operative type or due to experimental heating of the body, as in DEROBERT's experiments.

Also the clinical signs in shock are very much like those in hyperthermia. If, for instance, we take QUÉNY's enumeration of the signs associated with hyperthermia we may see that they cover practically exactly what is generally regarded as a late shock, *i. e.* paleness, tachycardia, hypotension, tachypnoea, torpor, small convulsions, loss of consciousness, quick onset, development, and death. Or if we take GOSSET's<sup>1</sup> description (third case, 24 hours after the operation): "*le diagnostic est certain: c'est un syndrome de pâleur-hyperthermie typique: le malade est livide, couvert de sueurs froids, la température est 40.1°, le pouls à 140. La tension artérielle est réellement imprenable.*" This condition would probably by most doctors be regarded as one of late postoperative shock. The following are the well-known clinical signs of shock (in extract after KÖSTER's description): paleness, greyish cyanosis, cool, perspiring extremities (even if the body temperature is high), small, quick pulse, hypotension, and superficial, often rapid respiration. The patients are remote, but conscious. At last there occur fibrillar twitchings (rarely convulsions), restlessness, and loss of consciousness. There is hardly anyone who would venture to make a differential diagnosis between hyperthermia and shock on the basis of these clinical descriptions. As, moreover, it has been shown that the rectal temperature may be high in tardive postoperative shock, sometimes also reaching hyperthermia values, and as haemoconcentration and occasionally hypoproteinaemia

<sup>1</sup> GOSSET's second case cannot be acknowledged as one of genuine postoperative hyperthermia, because the maximal temperature (40.1°C) was not attained till the 5th day after the operation and the fall occurred gradually until the 14th day. Thus the sudden change of temperature characteristic of proper postoperative hyperthermia is not found here. The course of the temperature curve seems suggestive rather of pulmonary or abdominal infection.

are observed in association with hyperthermia, just like with shock, then the interrelation between the two conditions seems even more intimate.

### Why Shock May Involve Hyperthermia.

After the pointing out of a marked and in many respects exceedingly intimate interrelation between postoperative hyperthermia and shock it remains to be found out whether the pathophysiology of the shock presents such conditions that the shock in itself may involve a rise in temperature.

Shock is associated with arteriolar contraction (PAGE). The effect of this contraction is observed on the skin by a reduction of the skin temperature, at first of the more peripheral parts of the body and later more centrally. In the parenchymatous organs and the musculature the arteriolar contraction likewise effects a reduced flow of blood with anoxia and resulting decreased oxidation and heat production. The arteriolar contraction is not part of the heat regulation, but is due to the endeavours of the organism to conduct the reduced circulating amounts of blood to the most important organs at the sacrifice of the less important. Gradually as the shock proceeds we get — as CHIEVITZ (p. 67) words it — “the condition occurring when the organism aims at maintaining the blood pressure in the internal carotid in order to procure sufficient circulation for the vital centres in the medulla oblongata . . . The organism will then, by universal arteriolar contraction (which, however, does not include the internal carotid area) try to inhibit the remaining circulation to the greatest possible extent, in order that as much blood as possible may circulate under pressure to the medulla oblongata”. In the shock organism must thus concentrate entirely on supplying blood to the medulla oblongata. Even the temperature regulation will have to be neglected, a fact which results in the above deviations from the normal with regard to body temperature. The deviation may tend in the direction of hypothermia or hyperthermia depending in the individual cases on the fact whether the greatest reduction occurs in the production or in the elimination of heat. The elimination of heat in shock is inhibited not only by the reduced circulation in the skin itself and the resulting cooling down; but also the internal convection, the transmission of heat from the thermogenetic to the thermolytic organs is diminished on account of the reduced circulation. The

body temperature rises if the decrease in the elimination of heat is relatively greater than that in the production of heat. Under normal conditions the warmer blood would, through impulses from Aronsohn-Sach's heat centre, cause arteriolar dilatation, warm skin, and a fall in temperature. In shock patients, on the other hand, the impulse to continued arteriolar contraction is the stronger from vitally important causes, and the body temperature, therefore, remains high or even increases.

Thus, in the pathophysiological reactions of the shock there are found weighty factors which under certain circumstances may very well bring about an increased body temperature. That successful treatment of the shock in such cases effects a fall in the body temperature is likewise easy to understand. By blood transfusion etc. the circulating amount of blood is increased and the arterioles relax. The skin becomes warm again and is now able to eliminate the excess of calories in the body.

### Previous Statements Concerning the Interrelation Between Hyperthermia and Shock.

Although an interrelation between postoperative hyperthermia and shock does not seem to have been established by any previous writers the idea seems to have suggested itself to some surgeons. Thus LEVEUF, in his contribution to the discussion after QUÉNY's lecture in 1937, pointed out the paleness as a sign common to both conditions. SOUPAULT, in another discussion (1942), declared dehydration to be an important pathogenetic factor in hyperthermia, which he has treated successfully with large intravenous doses of serum. On the whole fluid therapy has often been applied. MONDOR, LEVEUF, and BOUDREAUX treated their patients by blood transfusions, in some cases with a favourable result. MONOD seems to regard hyperthermia as a frequent sign in the symptomatology of shock. At least he writes that after brusque severing in extrapleural pneumolysis "*un choc organique assez marque peut se produire avec pâleur, tachycardie et temperature à 40°*", while a little earlier he states that the temperature in otherwise afebrile patients never exceeds 38.5°C after extrapleural pneumothorax. Also ÁKERRÉN (1943 and 1945) has advocated an interrelation between the two conditions (children).

The first and only writer who has definitely pointed out that postoperative hyperthermia is a form of shock is probably the

Danish writer LÜTKEN (a). In a discussion on infant hyperthermia in 1938 he declared as follows, "During some investigations made for other purposes I got to take an interest in the different forms of traumatic collapse (shock). One of these forms is the postoperative hyperthermia in infants." This is all, and unfortunately LÜTKEN has never accounted for his view, nor has he later discussed the problem. The first proper recognition of an interrelation between hyperthermia and shock seems nevertheless justly creditable to LÜTKEN.

### Supplementary Remarks.

The rare observation of increased body temperature in association with postoperative shock is probably due a. o. to the short duration of the fever, at least at the hyperthermia level. The shock is treated immediately after its recognition, without the course of the temperature curve being awaited. It is then a matter of chance whether the hyperthermia occurs just at the point of time for the routine measurement of temperature. Gradually as the improvements of our clinical and laboratory aids for early diagnosis cause shock to be treated earlier and earlier postoperative hyperthermia will probably become an increasingly rare phenomenon.

In certain cases the facts mentioned above may become of forensic importance. This was the case with a patient admitted with a gunshot wound in the thorax (No. 11 in Table 1, case IV). On admission the temperature was  $39.5^{\circ}\text{C}$ . After treatment of the shock the temperature fell to  $37.8^{\circ}\text{C}$ . In the evening it was  $38.3^{\circ}$ , after which it gradually fell. Neither blood cultivation immediately on admission nor the further course revealed signs of infection. Consequently there is reason to presume that the high temperature on admission was due chiefly to the shock. According to the first reports the patient had been wounded an hour and a half before admission. It could, however, be maintained with rather great certainty that a longer time must have elapsed (unless the patient had a fever already when wounded, which did not seem to have been the case), for in none of the previously observed cases of shock with fever did the temperature rise by more than scarcely one half degree per hour. Calculations show, moreover, that with a normal basal metabolic rate the body temperature in adults cannot rise much faster, not even when the elimination of heat has become completely checked (LUNDGAARD). In the present case police



examinations undertaken later brought out that the shot had been fired nearly four hours prior to the patient's admission. This accorded well with the calculations.

These facts may likewise be of practical importance from a medical point of view, as here where, in order to avoid another shock, revision and suturing of the wound was delayed as long as the chance of infection would justify it, *i. e.* till six hours after the lesion. The time was reckoned on the basis of calculations from the temperature and not on that of the — as later appeared — less reliable anamnestic data.

Neurogenous hyperthermia presents a clinical picture which in many respects resembles that of shock hyperthermia. The rise in temperature is abrupt, there are cold extremities and a relatively warm trunk, and there is found tachycardia with a pulse rate of 140 to 180 (ERICKSON). Here, too, the reduced elimination of heat should be pointed out as an important part of the pathogenesis.

The infant hyperthermia often presents an analogous picture. It occurs a few hours after the operation. The infants are pale and the pulse small and quick. On the other hand the skin is often warm all over, at least when the high temperature has been reached, and it is by no means always particularly shocking operations that involve hyperthermia in infants. Both OMBRÉDANNE and NIELSEN have pointed out (independently of each other) that the condition is also here probably due to a reduced elimination of heat. The vasoconstriction in hyperthermia has been plainly demonstrated by VALLERY-RADOT et al. NIELSEN's treatment with cold baths is motivated by the reduced elimination of heat. It is only natural that infants should be particularly exposed to hyperthermia due to bad thermolysis, because their body surface is relatively much larger than that of adults, and a dysregulation, therefore, more easily attended with severe consequences. The patho-anatomical changes in association with infant hyperthermia have been studied specially by French investigators (cited by ALAJOUANINE & QUÉNY and MARQUÉZY & LADET). They resemble to a great extent those in shock as described for instance by Moon.

A third condition which has many clinical features in common with postoperative hyperthermia is the general premortal stage of numerous different diseases. Hyperthermia is often observed here (QUINCKE) together with cool, perspiring skin, and a small, quick pulse, in other words again a combination of shock and hyperthermia.

Little is known of the proper causes of all these conditions. One thing is certain, however, that infection is not the cause of the poor condition of these patients, as appears from the following facts: 1) the prompt occurrence of hyperthermia after the operation; 2) the distinctly dysregulatory type of the fever; 3) lacking demonstrable signs of infection, *i. e.* negative blood cultures, no shivering fits, no subsequent signs or symptoms of infection, autopsies without remarkable findings, and occurrence — in infants — after unbloody operations and after surgical intervention without anaesthesia. Certain facts seem suggestive of the presence of hyperadrenalaemia, *viz.* arteriolar contraction, paleness, perspiration, and piloerection. Adrenalin is a pyrogenic substance (LAACHE, p. 54); but it is doubtful whether its effect is due exclusively to vasoconstriction.

On the whole endocrine conditions are hardly without a certain influence on the hyperthermia. BOUDREAUX's patient had myxoedema, and GOSSET's third patient presented enlargement of the sella turcica. In two of MARTIN's three cases the postmortem examination revealed lesion of the adrenal cortex (primary or secondary?). A certain predisposing, constitutional factor seems probable, too. Thus GOSSET's first patient got hyperthermia twice at an interval of two years, and in case No. 1 reported in the present paper the condition was observed three times within one month.

There has been some disagreement with regard to the term to be applied for this form of fever. The most commonly applied terms are those of hyperthermia and hyperpyrexia. The former should alone be used, partly for historical reasons (OMBRÉDANNE used it) and partly — as pointed out by LÜTKEN (b) — because the pathogenesis is not an increased heat production, but a decreased heat elimination.

Finally there is reason to emphasize that not all abrupt rises in temperature following operation can be explained as signs of shock. In two cases of pulmonary tuberculosis within the above-mentioned observation period temperatures over 40°C were observed the day after thoracoplasty and lobectomy respectively. There were no shock symptoms. In both cases the further course revealed tuberculous spreading to sound pulmonary areas, although the first skiagrams showed no such spreading. In one case of pulmonary abscess there occurred severe pneumococcus pneumonia after pneumotomy. Here, too, the operation was followed by an

abruptly rising temperature, but at the same time by shivering fits, positive blood cultures, and pathognomonic X-ray findings already the day after the operation. Finally hyperthermia was seen after thoracotomy with excision of a large intrathoracic goitre without thyrotoxicosis. No cause of the fever could be demonstrated here, neither during the illness nor on autopsy. There were no shock symptoms. Nevertheless blood transfusions were attempted, but without the slightest effect.

Thus it appears that hyperthermia still presents various unsolved problems. But it seems justifiable to maintain that *in a number of cases the hyperthermia is due to simple postoperative shock.*

### Summary.

Numerous cases of postoperative hyperthermia in adults have clinical, pathophysiological, and patho-anatomical features in common with postoperative shock. It is pointed out that the abrupt temperature rise occurs without shivering fits and that the perspiration ceases during the temperature fall.

Typical postoperative shock is often found to be associated with a sudden rise in temperature. The temperature promptly falls after treatment of the shock. Blood cultures, further clinical course, and autopsies reveal no signs of infection.

The rise in temperature attending shock is due to reduced elimination of heat because of arteriolar contraction, notably in the extremities.

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# On Penicillin Treatment of Acute Hematogenous Osteomyelitis.

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The treatment of osteomyelitis was earlier a purely surgical problem until the sulfadugs were introduced. The results obtained with sulfa-medication did not fulfill the hopes set on this treatment. It was found that these preparations given per os or administered as injection had only to a certain degree an effect upon the septic general infection in the acute stage and, mostly applied locally, in the late stage in connection with surgery. Still greater hopes were attached to the penicillin. FLOREY, M. B. and H. W., wrote (1943): "In the future the osteomyelitis will no longer be a surgical condition." Increased experience showed, however, this optimism to be premature. Thus only 9 out of M. AGERHOLM's and J. TRUETA's 30 cases, were cured with penicillin treatment alone while the rest needed further various surgical measures. BAUER, W., and KOLMER, J. A., on the other hand, state in their general surveys which are based on 713 and 141 cases respectively, collected from literature, that the effect of penicillin is temporary or non-existent in 11 per cent of the cases, in some cases even in spite of simultaneous surgical interference. As the published material has been comparatively limited and as the frequency of acute hematogenous osteomyelitis in Finland now seems to increase, we feel justified in collecting case material from different hospitals in order to elucidate on this basis the results obtained here with penicillin treatment of the disease, and the factors influencing its effect. (One of these factors is possibly the varying k- and g-penicillin-concentration of the preparations of the various factories. The age of these preparations also varied considerably.)

## Material and Methods of Treatment.

Our material comprises 83 cases of osteomyelitis located to 92 bones. Ten patients were adults and the remainder children below 17 years. 34 were female and 49 male. The sites of infection were: tibia 37, femur 28, humerus 6, radius 4, fibula 5, ulna and the os metatarsale, costa, pelvis and calcaneus 2 cases of each, and clavícula and os metacarpale 1 case of each. In 5 patients the disease was simultaneously located to 2 and in 2 patients to 3 or several bones. The last mentioned cases have in the following been referred to several different groups according to each location of the osteomyelitis.

The infecting organism was determined in 60 patients. In 2 patients streptococci were found, in one both strepto- and staphylococci, in one staphylococcus albus and in the remainder staphylococcus aureus.

The sensitivity to penicillin of the infecting organism was determined in vitro (the sero-bacteriological Institute of the University of Helsinki) only in 8 cases treated at the Pediatric Clinic, and it was in all cases considerable.

Based on the clinical disease picture the cases were divided into two groups. One comprised 21 cases and in these the general symptoms were slight even in the beginning of the disease, the course of the disease was slow and prolonged, and the bone changes which were roentgenologically established, were principally of sclerosing or osteoplastic type (the so-called primarily chronic type of osteomyelitis). In the second group to which 71 cases were referred, the beginning of the disease was characterized by high fever and more or less septic general symptoms, the bone process being principally osteolytic with rather marked decalcification phenomena (the proper acute cases). The results of penicillin treatment of the primarily different cases of these groups can no more than the results of any other treatment, be directly compared to one another, and they are therefore also dealt with separately.

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<sup>1</sup> Out of our cases 36 patients were treated at the surgical department of the Pediatric Clinic (SULAMAA), 6 at the Loimaa District Hospital (VUORI) and the remainder at the Red Cross Hospital, the Maria Hospital of Helsinki, the Town Hospitals of Vaasa and Tampere, the County Hospitals of Kuopio, Oulu and Vaasa, the General Hospitals of Joensuu, Kotka and Tampere and at the District Hospital of Rautalampi. We beg to express our gratitude to the Chiefs of these Hospitals for their great kindness in placing their material of records and roentgenograms at our disposal.

The principles of therapy in the hospitals from which our material has been collected, varied considerably both with regard to the penicillin dosage and to the additional surgical measures. Due partly to difficulties in obtaining penicillin, to its scarcity and high price, but also partly to the late arrival of the patients in hospital, penicillin treatment was often commenced rather late. 4 patients only received penicillin already within 2 days from the onset of the disease and in 40 patients only did the treatment begin within the first week of illness. In primarily chronic cases penicillin was generally administered rather late, on an average after one month, in connection with the first surgical treatment. Due to these reasons the daily dosage of penicillin was, compared to the standard doses recommended in literature, small (less than 160,000 units daily) in 61 cases and only in 29 cases comparatively adequate (over 160,000 units daily). For the same reasons the total dosage in half of our cases was smaller and the course of the treatment thus shorter than what is elsewhere nowadays considered correct. With regard to the surgical treatment our material is in one respect uneven, inasmuch as in addition to incision, trepanation or drilling was performed with a few exceptions only in the 10 cases treated in the acute stage by ourselves. The manifoldness of the methods of treatment hampered our investigation as the dividing of the small material into groups, prevented us from obtaining in every instance statistically conclusive results.

### Results of Treatment:

#### *The effect of penicillin on the general symptoms:*

Not even when the penicillin treatment is most successful does the temperature fall critically, but gradually lytically. If the fever and the septic symptoms do not decrease it is probably a question of an infecting organism which is penicillin resistant. Such strains of staphylococcus aureus are calculated to 5 per cent (FLOREY, H. W., JENNINGS, M. A.). If, on the other hand, the septic symptoms disappear while a low fever continues, this circumstance indicates the presence of a focus of infection which the penicillin cannot easily reach through the blood.

Based on the clinical development of the disease, one would seem entitled to consider the infecting organism in the following

2 cases resistant to penicillin, although the sensitivity was not determined in vitro:

1. On admission to the Pediatric Clinic of Helsinki a boy, aged 7 years, had already had high septic fever during 10 days, his general condition was poor, and the region of both knees and the left tarsal region were painful and swollen. He was immediately given 320,000 units of penicillin daily and sulfathiazole. 4 days later subperiosteal abscesses in both tibiae and prepatellar purulent bursitis on the right side were incised. The fibrino purulent contents of the left knee joint was daily evacuated by puncture and penicillin was instead injected. Not until the daily dose of penicillin was gradually increased to 520,000 units did the fever slowly abate, the patient remaining subfebrile. He was given totally 11.5 million units of penicillin. The general condition improved quickly and in spite of the size of the foci these healed without any further measures in all other bones except the left tibia in which radical trepanation had to be performed 6 months after the onset of the disease.

2. A girl, aged 13 years, was admitted into the Loimaa District Hospital with high septic fever, and the diagnosis given as *Myositis purulenta psoatis l. dx.* Beginning on the third day of the disease she received penicillin and sulfa treatment (in the course of 10 days 1 million units penicillin and 60 gr sulfathiazole). However, the temperature fell but little. Not until 4 weeks later was an abscess, caused by *staphylococcus aureus*, found and opened in the right psoas. The fever, over  $38^{\circ}$ , continued and again after 4 weeks a new abscess was opened orally in the psoas both from the front and the back. The x-ray examination negative. As a fever of almost  $38^{\circ}$  still continued a new course of penicillin treatment of 1 million units was given; however without any evident result. Not until now, almost 3 months after the onset of the disease, did roentgenological symptoms of osteomyelitis appear, viz. caries at the bottom of the acetabulum and periosteal reaction in the area of the pecten pubis. The periosteum and the bone seemed even on inspection intact at the time of the canalization of the abscesses. The canalization was further improved through opening the joint from outside. At the same time traction was applied. The patient was still subfebrile. 3 weeks later epiphysiolysis occurred in the neck of the femur. As the caput did not consolidate but necrosed gradually, sequestrectomy was performed some months later through the original canalization opening above the groin through gouging the bottom of the acetabulum. The cavity thus obtained was filled with a paste of sulfathiazole and penicillin, the wound was sutured and the joint was immobilized by means of plaster of Paris. Osseal ankylosis occurred within 2—3 months.

In the first case daily doses of penicillin which were even larger than normal did not, if judged by the temperature curve, at all effect the violently septic picture of this disease which was localised to three different bones and to the knee joint. However, when



the dosage was persistently increased finally reaching 500,000 units daily, a change for the better was at last observed. In our opinion, the merit of saving the patient's life must be ascribed to penicillin, which appears from the fact that, although the disease was extremely serious, sequestration occurred only in 1 of the osseal foci which required radical operation. A vigorous treatment showed the bacterium which at first seemed penicillin-resistant to be only relatively resistant. In the second case an early penicillin course of treatment, 100,000 units daily, was ineffective.

An unsuitable method of treatment is shown in the following case:

3. A girl, aged 6 years, had suffered, before admission, during a couple of days from fever ad  $39^{\circ}$  and pain in the right thigh. Roentgenogram and puncture: Nihil. Plaster trousers were applied and the patient received during 4 days a total of 195,000 units of penicillin. During this time the fever fell lytically to normal, then increasing intermittently after the end of the treatment to almost  $40^{\circ}$ . After an interval of 2 days penicillin treatment was therefore recommenced. During these two days the patient had received only sulfathiazole, and a metastatic phlegmon of the left wrist had been opened. These measures did not, however, have any evident effect, and during this time a new metastatic focus developed in the right thumb. Roentgenogram of the right neck of the femur showed clear osteomyelitic changes. The penicillin treatment (totally 285,000 units) was for some reason discontinued already after 7 days. The patient died of sepsis 6 days later.

It is uncertain whether the girl's life could have been saved through a more intensive course of treatment which in the first case, though it seemed hopeless, finally lead to a good result. Interruption of the treatment both in the beginning when the temperature fell and later after 6 days of treatment, must be considered due to lack of skill.

This was the only death in our material. The mortality rate was thus  $1.2 \pm 1.2$  per cent.<sup>1</sup> In W. BAUER's statistics the corresponding value was  $1.1 \pm 0.4$  per cent.

In our material penicillin treatment, with the exception of the cases presented in the foregoing, had a clearly favourable effect upon the general symptoms. A continuous subfebrile condition during the course of treatment or a later increase of the temperature after the end of the treatment which occurred in many of our cases, were probably due to the presence of such osseal foci which the penicillin could not reach by means of the blood vessels. In

<sup>1</sup>  $1.4 \pm 1.3$  per cent in the proper acute cases.

most of these cases surgical interference was later necessary. The reason for a renewed fever need not, however, always be a "surgical" focus in the proper sense of the word. The course of the treatment may simply have been not only too weak but also too short. There are cases in our material in which such a fever disappeared after renewed intensive penicillin treatment without surgical interference. Besides a normal daily dosage (160,000 units) a course of treatment of sufficient duration is now stressed. W. GRÜNINGER thus writes: "Die Behandlungsdauer wird in der Regel kaum weniger als 2—3 Wochen betragen, oft aber beträchtlich mehr."

The septicopyemic initial stage of acute hematogenous osteomyelitis has the character of a general infection, and was earlier capricious as to its development and therapeutically hard to influence, but can now generally, provided it is not caused by a totally resistant infecting organism, be completely checked with penicillin. Therefore, the mortality of this disease which was earlier calculated at 10—20 per cent (TIIITINEN, E.), is now almost nought. One can say that the penicillin treatment has often changed an acute osteomyelitis general infection into a local bone infection or osteitis.

### *The effect of penicillin on a local bone process.*

A condition for successful penicillin treatment is a continuous penicillin concentration in the blood corresponding to the penicillin sensitivity of the infecting organism. In order to maintain such concentration an adequate dose and a sufficiently short interval between the injections are necessary. Intervals of 3 hours are considered the most appropriate when injections are given intramuscularly. It would therefore be easy to determine the correct penicillin dose for each separate case on the penicillin-sensitivity of the infecting organism, provided the infecting organism and its penicillin sensitivity be known already at the initial stage of the disease. The effect of penicillin on the local bone process, however, depends on a whole series of other factors. A primary condition is naturally the free access of the penicillin to the osseal foci, which again depends on the pathological-anatomical condition of the bone area in question. The effect is poor or even non-existent if the affected area is isolated by thrombi or if it is totally necrotized, viz. if the case has reached the abscess or even the sequester stage. The pathological-anatomical condition depends both on the

virulence of the infecting organism and the necro-toxins produced by it, as also on the thrombosing, pus formation and other reactions of the organism. For these reasons the character of the osteomyelitis is sometimes rapid, sometimes slow, in some cases osteoplastic and in others osteolytic. As the cases are already primarily different, the adequate penicillin dose cannot be calculated and it is equally difficult to determine a standard minimum dose. In practice a schematic treatment must therefore be applied with doses which have been found adequate for most instance, even though this means a considerable waste of penicillin in the treatment of less serious cases.

The pathological-anatomical condition depends on the time from the onset of the disease and many other factors so that no 'in time — too late' limits for the beginning of penicillin treatment can be assessed. For the comparison of the cases of our material we have, however, determined a limit of 7 days.

For the determination of the character and extent of the bone process, roentgenological investigation is necessary. However, it is of no greater assistance in this respect than in diagnosing, until 3 to 4 weeks after the onset of the disease, as osteomyelitic changes in the bone cannot generally be roentgenologically established earlier. Even then and sometimes much later judging of the pathological-anatomical condition of the affected bone area and prognostication with the aid of roentgenograms is very difficult, as even the most serious decalcification does not always mean necrosis. It is therefore important to follow the development of the process by means of roentgenograms at sufficiently short intervals. For the sake of comparison we have divided our material into two principal types according to the character of the bone process: those in which the process, even at its worst, seems mainly osteoplastic, and those in which it seems mainly osteolytic.

We have classified our material according to the manner of recovery as follows:

A = healed in the acute stage of the disease, subgroups:

A<sub>1</sub> = healed after penicillin treatment only,

A<sub>2</sub> = healed after penicillin treatment + incision, drilling or primary trepanation.

B = healed in the chronic stage of the disease, subgroups:

B<sub>1</sub> = cases in which the process, after an apparent recovery due to penicillin treatment, continued without clinical symptoms of any appreciable degree, often later demanding sequestrec-

tomy or radical trepanation (masked disease, osteomyelitis larvata),

B<sub>2</sub> = healed after sequestrectomy or radical operation,

B<sub>3</sub> = cases in which sequestrectomy or radical trepanation has already been performed but which still remain unhealed.

The healing in our material appears from table 1.

Table 1.

Manner of healing	Number of cases	Percentage
A { A <sub>1</sub> ..... A <sub>2</sub> ..... }	$\left. \begin{matrix} 22 \\ 31 \end{matrix} \right\} 53$	$\left. \begin{matrix} 24 \pm 4.5 \\ 34 \pm 4.9 \end{matrix} \right\} 58 \pm 5.2$
B { B <sub>1</sub> ..... B <sub>2</sub> ..... B <sub>3</sub> ..... }	$\left. \begin{matrix} 5 \\ 28 \\ 5 \end{matrix} \right\} 38$	$\left. \begin{matrix} 5.5 \pm 4.9 \\ 31 \pm 4.8 \\ 5.5 \pm 2.4 \end{matrix} \right\} 42 \pm 5.2$

This table shows that about one fourth of all cases healed after penicillin treatment only, and about one third after penicillin treatment and operations performed in the acute stage, almost one half healing only after operations performed in the chronic stage. The effect of penicillin on the bone process can thus be said to have been good, fairly good and poor respectively.

A closer examination of the results shows that the healing probably depends on:

1. factors due to the disease itself or primary factors:
  - a. the general clinical character of the disease, viz. whether it is acute or primarily chronic at onset,
  - b. the mode of development of the local bone process, viz. whether the process is principally osteoplastic or osteolytic.
2. the treatment of the disease or secondary factors:
  - c. the time when penicillin treatment commenced, and
  - d. the intensity of the treatment.

1. a. When comparing the results of acute and primarily chronic cases (table 2) we find that one half of the acute cases were healed already in the acute stage with penicillin treatment only or with penicillin + surgical treatment, the other half healing only after operations performed in the chronic stage. In the group of primarily chronic cases the relation was considerably more favourable,  $81 \pm 8.5$  per cent healing in the first mentioned manner and only  $19 \pm 8.5$  per cent being prolonged into a chronic stage, with radical operations. It is statistically

Table 2.

Manner of healing	Acute cases		Primarily chronic cases		Difference
	Number of cases	Percent-age	Number of cases	Percent-age	
A { A <sub>1</sub> ..... A <sub>2</sub> ..... }	16 } 36 20 }	50 ± 6	6 } 17 11 }	81 ± 8.5	31 ± 10
B { B <sub>1</sub> ..... B <sub>2</sub> ..... B <sub>3</sub> ..... }	5 } 34 25 } 4 }	50 ± 6	0 } 4 3 } 1 }	19 ± 8.5	31 ± 10

Table 3.

Manner of healing	Osteoplastic cases		Osteolytic cases		Difference
	Number of cases	Percent-age	Number of cases	Percent-age	
A { A <sub>1</sub> ..... A <sub>2</sub> ..... }	14 } 30 16 }	91 ± 5.1	8 } 23 15 }	40 ± 6.4	51 ± 8.1
B { B <sub>1</sub> ..... B <sub>2</sub> ..... B <sub>3</sub> ..... }	1 } 3 1 } 1 }	9 ± 5.1	4 } 35 27 } 4 }	60 ± 6.4	51 ± 8.1

significant that these primarily chronic cases are prognostically less serious, a fact which seems natural enough as they are less affected.

b. The bone process was of an osteoplastic type in 22 and of osteolytic type in 49 (the one case which died included) acute cases, and in the primarily chronic cases these numbers were 11 and 10 respectively. It therefore seems as if an osteoplastic process were more common in primarily chronic cases than in acute cases. This cannot, however, be proved statistically on the basis of our material (the difference between the percentages being  $21 \pm 11$  per cent). On the other hand it shows significantly (the difference of the percentages being  $51 \pm 8$  per cent when all and  $55 \pm 9.5$  per cent when the acute cases only are included) that the prognosis is comparatively better in cases of the osteoplastic type than of the osteolytic type (table 3). Almost all of the former heal already in the acute stage whereas this is the case only in  $40 \pm 6.4$  per cent of the latter. This difference shows that the penicillin must have a much better effect on osteoplastic

Table 4.

Type	The penicillin treatment commenced				Difference
	Not later than on the 7th day		After the 7th day		
	Number of cases	Percent-age	Number of cases	Percent-age	
Osteoplastic .....	18	51 ± 8.5	4	16 ± 7.2	35 ± 11
Osteolytic .....	17	49 ± 8.5	21	84 ± 7.2	35 ± 11

osseal foci than on osteolytic foci. The fact that  $40 \pm 6.4$  per cent of the osteolytic cases are healed already in the acute stage must be almost entirely ascribed to the effect of the penicillin as without it most of them would have become chronic.

Whether the bone process becomes osteoplastic or osteolytic does probably not depend only on factors included in the disease itself, but also on the penicillin treatment, viz. the time when the treatment commences and the size of the daily doses. When investigating this matter in our series (considering only acute cases) we find that there is a significant correlation with regard to the moment at which the penicillin treatment began. Cases of osteoplastic type occurred considerably more often among those which came under penicillin treatment during the first week than among those on whom treatment began later (table 4).

On the other hand we cannot on the basis of our material prove the existence of any evident correlation between the quantity of penicillin used and the manner of development of the bone process.

2. c. Our material does not either allow us to draw any other conclusions as to the influence of early or late commencement of penicillin treatment than was already done in the foregoing, as the percental difference is so trifling (table 5, acute cases only). There is no point in drawing the limit at a time shorter than 7 days as, for instance, all 4 cases in which penicillin treatment was commenced already after 2 days from the onset of the disease in spite of the treatment (daily doses of 80,000—320,000 units) developed an osteolytic form healing only after operations performed in the chronic stage. Further, patients very seldom arrive for treatment on the very first days of their illness which makes a very early commencement of treatment for the most part im-

Table 5.

Manner of healing	The penicillin treatment commenced				Difference		
	Not later than on the 7th day		After the 7th day				
	Number of cases	Percent-age	Number of cases	Percent-age			
A { A <sub>1</sub> ..... A <sub>2</sub> ..... A <sub>3</sub> ..... A <sub>4</sub> ..... A <sub>5</sub> ..... A <sub>6</sub> ..... A <sub>7</sub> ..... A <sub>8</sub> ..... A <sub>9</sub> ..... A <sub>10</sub> ..... A <sub>11</sub> ..... A <sub>12</sub> ..... A <sub>13</sub> ..... A <sub>14</sub> ..... A <sub>15</sub> ..... A <sub>16</sub> ..... A <sub>17</sub> ..... A <sub>18</sub> ..... A <sub>19</sub> ..... A <sub>20</sub> ..... A <sub>21</sub> ..... A <sub>22</sub> ..... A <sub>23</sub> ..... A <sub>24</sub> ..... A <sub>25</sub> ..... A <sub>26</sub> ..... A <sub>27</sub> ..... A <sub>28</sub> ..... A <sub>29</sub> ..... A <sub>30</sub> ..... A <sub>31</sub> ..... A <sub>32</sub> ..... A <sub>33</sub> ..... A <sub>34</sub> ..... A <sub>35</sub> ..... A <sub>36</sub> ..... A <sub>37</sub> ..... A <sub>38</sub> ..... A <sub>39</sub> ..... A <sub>40</sub> ..... A <sub>41</sub> ..... A <sub>42</sub> ..... A <sub>43</sub> ..... A <sub>44</sub> ..... A <sub>45</sub> ..... A <sub>46</sub> ..... A <sub>47</sub> ..... A <sub>48</sub> ..... A <sub>49</sub> ..... A <sub>50</sub> ..... A <sub>51</sub> ..... A <sub>52</sub> ..... A <sub>53</sub> ..... A <sub>54</sub> ..... A <sub>55</sub> ..... A <sub>56</sub> ..... A <sub>57</sub> ..... A <sub>58</sub> ..... A <sub>59</sub> ..... A <sub>60</sub> ..... A <sub>61</sub> ..... A <sub>62</sub> ..... A <sub>63</sub> ..... A <sub>64</sub> ..... A <sub>65</sub> ..... A <sub>66</sub> ..... A <sub>67</sub> ..... A <sub>68</sub> ..... A <sub>69</sub> ..... A <sub>70</sub> ..... A <sub>71</sub> ..... A <sub>72</sub> ..... A <sub>73</sub> ..... A <sub>74</sub> ..... A <sub>75</sub> ..... A <sub>76</sub> ..... A <sub>77</sub> ..... A <sub>78</sub> ..... A <sub>79</sub> ..... A <sub>80</sub> ..... A <sub>81</sub> ..... A <sub>82</sub> ..... A <sub>83</sub> ..... A <sub>84</sub> ..... A <sub>85</sub> ..... A <sub>86</sub> ..... A <sub>87</sub> ..... A <sub>88</sub> ..... A <sub>89</sub> ..... A <sub>90</sub> ..... A <sub>91</sub> ..... A <sub>92</sub> ..... A <sub>93</sub> ..... A <sub>94</sub> ..... A <sub>95</sub> ..... A <sub>96</sub> ..... A <sub>97</sub> ..... A <sub>98</sub> ..... A <sub>99</sub> ..... A <sub>100</sub> .....	11 13	24	53 ± 7.5	5 7	12	48 ± 10	5 ± 12.5
B { B <sub>1</sub> ..... B <sub>2</sub> ..... B <sub>3</sub> ..... B <sub>4</sub> ..... B <sub>5</sub> ..... B <sub>6</sub> ..... B <sub>7</sub> ..... B <sub>8</sub> ..... B <sub>9</sub> ..... B <sub>10</sub> ..... B <sub>11</sub> ..... B <sub>12</sub> ..... B <sub>13</sub> ..... B <sub>14</sub> ..... B <sub>15</sub> ..... B <sub>16</sub> ..... B <sub>17</sub> ..... B <sub>18</sub> ..... B <sub>19</sub> ..... B <sub>20</sub> ..... B <sub>21</sub> ..... B <sub>22</sub> ..... B <sub>23</sub> ..... B <sub>24</sub> ..... B <sub>25</sub> ..... B <sub>26</sub> ..... B <sub>27</sub> ..... B <sub>28</sub> ..... B <sub>29</sub> ..... B <sub>30</sub> ..... B <sub>31</sub> ..... B <sub>32</sub> ..... B <sub>33</sub> ..... B <sub>34</sub> ..... B <sub>35</sub> ..... B <sub>36</sub> ..... B <sub>37</sub> ..... B <sub>38</sub> ..... B <sub>39</sub> ..... B <sub>40</sub> ..... B <sub>41</sub> ..... B <sub>42</sub> ..... B <sub>43</sub> ..... B <sub>44</sub> ..... B <sub>45</sub> ..... B <sub>46</sub> ..... B <sub>47</sub> ..... B <sub>48</sub> ..... B <sub>49</sub> ..... B <sub>50</sub> ..... B <sub>51</sub> ..... B <sub>52</sub> ..... B <sub>53</sub> ..... B <sub>54</sub> ..... B <sub>55</sub> ..... B <sub>56</sub> ..... B <sub>57</sub> ..... B <sub>58</sub> ..... B <sub>59</sub> ..... B <sub>60</sub> ..... B <sub>61</sub> ..... B <sub>62</sub> ..... B <sub>63</sub> ..... B <sub>64</sub> ..... B <sub>65</sub> ..... B <sub>66</sub> ..... B <sub>67</sub> ..... B <sub>68</sub> ..... B <sub>69</sub> ..... B <sub>70</sub> ..... B <sub>71</sub> ..... B <sub>72</sub> ..... B <sub>73</sub> ..... B <sub>74</sub> ..... B <sub>75</sub> ..... B <sub>76</sub> ..... B <sub>77</sub> ..... B <sub>78</sub> ..... B <sub>79</sub> ..... B <sub>80</sub> ..... B <sub>81</sub> ..... B <sub>82</sub> ..... B <sub>83</sub> ..... B <sub>84</sub> ..... B <sub>85</sub> ..... B <sub>86</sub> ..... B <sub>87</sub> ..... B <sub>88</sub> ..... B <sub>89</sub> ..... B <sub>90</sub> ..... B <sub>91</sub> ..... B <sub>92</sub> ..... B <sub>93</sub> ..... B <sub>94</sub> ..... B <sub>95</sub> ..... B <sub>96</sub> ..... B <sub>97</sub> ..... B <sub>98</sub> ..... B <sub>99</sub> ..... B <sub>100</sub> .....	2 15 4	21	47 ± 7.5	3 10 0	13	52 ± 10	5 ± 12.5

possible in practice. In our material there are, inside the 7-day limit, 16 serious acute osteomyelitic cases in which an average time of 4.5 days elapsed before penicillin treatment commenced. On the other hand the treatment of the acute cases which recovered after penicillin treatment only, was commenced on an average as late as 8.5 days after the onset of the disease. It is therefore not possible to ascertain a general, fixed time from the onset of the disease after which the commencement of treatment might be considered too late, but each case has in this respect its own limit.

d. In elucidating the relation between the intensity of the treatment and the way of healing we have used 160,000 units, which was by GRÜNINGER, W., KOLMER, J. A., and others considered a normal daily dose, as a minimum limit, but have not arrived at any result which would be even statistically probable. A comparison based on the length of the course of treatment was just as resultless. The quantity of penicillin necessary for the healing is therefore individual in each case. But comparing the frequency of complications in the groups of acute cases treated with doses of less than 160,000 units and over 160,000 units daily we have received the impression that larger doses are apparently more favourable (table 6, the difference between the percentages  $29 \pm 13$  %. Three cases have not been considered as they had received two courses of treatment of different intensity).

*The effect of penicillin on an osteomyelitic bone process is thus considerably stronger in primarily chronic cases and in cases*

Table 6.

Complications:	Penicillin		Difference
	< 160,000 units daily (47 cases)	≥ 160,000 units daily (21 cases)	
Fistulae .....	3	2	
Sequestra (+ fistulae) .....	11	3	
Epiphyseolysis .....	4	—	
Spontaneous fracture .....	4	—	
Continuing in a larvate form .....	3	1	
Recidivation .....	6	1	
Arthritis of the adjacent joint .....	1	2	
Endocarditis .....	1	—	
Phlegmone metastatica + exitus .....	1	—	
Total	(72 ± 6.6 %)	(43 ± 10.8 %)	29 ± 13

which principally exhibit osteoplastic changes, than in acute cases and such which principally develop osteolytic changes.

With regard to the intensity of the penicillin treatment and the time of its commencement the conceptions "adequate dosage" and "sufficiently early" vary much in different cases depending on the varying forms of development of the osteomyelitic process. An irreparable damage to the bone may sometimes occur early, sometimes late and the focus may be accessible to penicillin, or isolated from the blood circulation.

The average duration of osteomyelitis is now, thanks to penicillin, considerably shorter, mainly due to an increase of the percentage of cases healed in the primary stage. Further, as sequestration is seldom now "total" in cases treated with penicillin, one need not for fear of fractures wait as long as earlier for the formation of new bone before radical trepanation. Neither is there any danger of a flaring up of the infection if penicillin is again given during the operation. The danger of recurrence is probably the same in cases treated with penicillin as in those without penicillin medication.

#### *On the necessity of surgical treatment.*

It appears clearly from our material that a treatment which is now considered adequate and as far as can be judged has been commenced sufficiently early, does not always guarantee an 'abortive' healing. However, this should be possible in the majority of the cases, as even in our material which on an average must be considered unfavourable with regard to the time of the com-



mencement of the treatment and the adequateness of the dosage, 24 per cent of the cases healed without bone changes worth mentioning and without operation.

The quantity of pus which is produced, is probably quite a secondary factor for the occurrence of bone changes, a subordinate reactive phenomenon. Although the pressure of the pus is not of such importance as one was earlier apt to believe (this has also been stated by TITINEN, E.) yet it must be removed, as in purulent cases treatment with penicillin only has proved insufficient. This is necessary as penicillin is not able to sterilize pus. ALTEMEIER, W. A. and HELMSWORTH, J. A. evacuated the subperiosteal abscess by means of puncture, and introduced penicillin instead, MCADAM, I. W. and AIRD, I. & BODIAN, M. through boring holes into the bone, AGERHOLM, M. & TRUETA, J. use both these methods or primarily trepanation. The pus is probably more important because of the necro- and other toxins dissolved in it than because of the few bacteria it contains. Surgical measures in purulent cases are also motivated by the fact that the pus deteriorates the nutrition of the bone through detaching the periosteum from it (AGERHOLM, M. & TRUETA, J.) and increasing the formation of periosteal callus in the stage of healing. In practice many of the cases of osteomyelitis will always require surgical treatment so that tissue which is not accessible to penicillin can be removed in accordance with classical principles. The use of heparin and dicumarin in addition to penicillin in fresh cases (SULAMAA, M., VUORI, E., SANDBLOM, PH.) may contribute to a certain degree towards avoiding the necrosing caused by thrombi. So far, however, lack of experience does not allow judgment of the results of this method.

Penicillin is of great value also in the treatment of cases in the chronic stage. When introducing an ample quantity of penicillin-sulfathiazole paste into the cavity resulting from a radical operation, the wound can be exactly sutured and may heal by first intention. In this case trepanation need not be performed as thoroughly as earlier. A thorough trepanation may also frequently prove dangerous by causing injury to the epiphyseal limits, destruction of the weight distribution etc. Besides classical muscle plastic the cavity can also be filled according to C. HENSCHEN's method with bone-meal, or, according to K. HOGEMAN, with bone chips, both mixed into penicillin-sulfathiazole paste.

### Summary.

The authors' material collected from several different hospitals, comprises 83 cases of osteomyelitis localized to 92 bones, 21 cases being primarily chronic and 62 being acute. As one patient died, probably because of an insufficient dosage of penicillin, with septic symptoms, the mortality was  $1.2 \pm 1.2$  per cent. In two cases the sensitivity to penicillin was not clinically quite evident. In the remaining cases the effect of penicillin upon the general infection of a more or less septic character at the initial stage was good.  $24 \pm 4.5$  per cent of the cases of osteomyelitis healed after penicillin treatment only,  $34 \pm 4.9$  per cent after penicillin treatment + incisions, drilling or primary trepanation performed in the acute stage. The disease became chronic in spite of the penicillin treatment in  $42 \pm 5.2$  per cent of the cases, and did not heal until sequestrectomy or radical trepanation had been performed. The penicillin treatment gave more significant results in the primarily chronic than in the acute cases, the difference being  $31 \pm 10$  per cent. The treatment was still more effective in the group of cases which showed principally osteoplastic roentgenological bone changes than in the group showing principally osteolytic changes, the percental difference between the osteoplastic and the osteolytic cases healed in the acute stage being  $51 \pm 8.1$ . No significant correlation between the recovery on one hand, and the intensity of the penicillin treatment and the time of its commencement on the other, could be proved. The fact that the group of cases which was treated with penicillin within the first week of illness, contained a significantly larger number of cases of the osteoplastic type than the group which came under treatment later (difference  $35 \pm 11$  per cent) indicated indirectly, however, that it is important to aim at as early treatment as possible, bearing in mind not only the treatment of the initial general infection but also the bone process. The relatively smaller frequency of complications in the group of patients treated with larger doses of penicillin (daily dose  $\geq 160,000$  units) indicated also indirectly the advantage of more intensive treatment.

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## Intestinal Suction Treatment (With the Miller-Abbott Tube).

By

S. S. KROOK, M. D.

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A continuous fall in the lethality of intestinal obstruction has taken place since the surgical treatment of this disease was commenced some 50--60 years ago, a fall that has perhaps been most marked during the last decade. In Anglo-Saxon countries there seems to be a tendency to put this last-mentioned improvement of the therapeutic results into association with the introduction of suction treatment. In Scandinavia this form of treatment — judging from the literature — has only been employed to a very little extent, probably owing in no small degree to the difficulty of procuring the necessary material during the years of war. Here, however, a fall in the lethality has also been recorded (Krook, 1947) that is fully comparable with and even surpasses that demonstrated in the Anglo-Saxon countries, and hence the paramount importance of treatment by suction for the results attained may already be questioned on that ground. Still, intestinal treatment by suction is undeniably a valuable addition to our therapeutic armamentarium in ileus conditions, and therefore a discussion of this treatment based upon experience from Sweden should be of value, so much the more so as the range of indications for this type of treatment is under lively debate.

The tube which is mostly employed for the institution of intestinal suction, and which has also been used in the author's material, was designed by MILLER and ABBOTT, 1934. It is furnished with two channels, one of which is attached to the suction apparatus and the other to a thin-walled rubber balloon, located

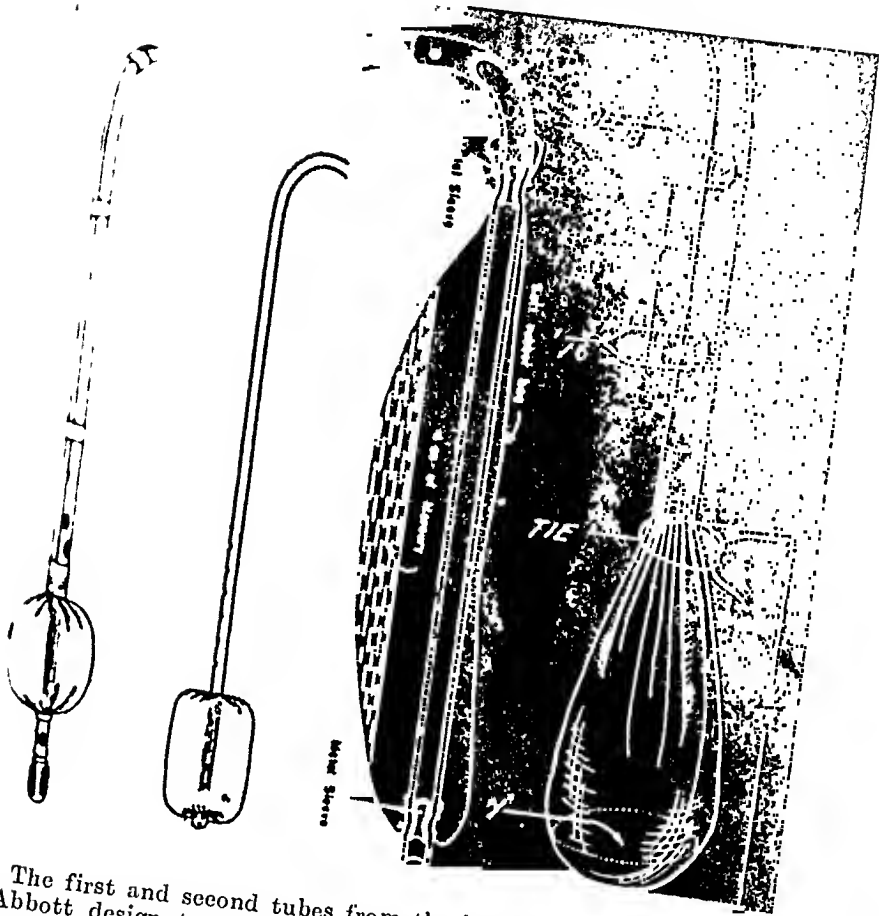


Fig. 1. The first and second tubes from the left show the principles of the Miller-Abbott design together with a modification. The third tube shows Harris's and the fourth Cantor's design. (From Cantor, Kennedy and Reynolds, *Am. J. Surg.*, 1947: 113: 437.)

at the tip of the tube, which can by this means be inflated with air to such an extent that it is gripped by the peristalsis of the intestinal wall and propelled in an anal direction. The greatest difficulty lies in getting the balloon to pass through the pylorus, as the tube shows a tendency to coil in the stomach with the result that the tip draws away from the pylorus. To facilitate the right adjustment of the tube ABBOTT, amongst others, made an attempt to provide it with a stylet, but this arrangement has generally been regarded as too risky. HARRIS has designed a type in which the balloon is supplied with a couple of millilitres of mercury, the weight of which is considered sufficient to render the balloon tractable to peristaltic action. Inflation is then regarded as unnecessary, which has the advantage that the tube need not

contain more than one channel and can accordingly be made more slender. HERRERA, MILLET and LAWRENCE<sup>1</sup> among others have reported cases in which the balloon has burst without any harmful effect being noticed from the mercury that had run out into the intestine. A modification of a tube with mercury of this kind has been launched by CANTOR<sup>2</sup>, and CANTOR, KENNEDY and REYNOLDS<sup>3</sup> have published a report of the results obtained. At Södersjukhuset we have only very little practical experience of these mercury tubes, but are hoping to have some soon, having recently succeeded in procuring a Cantor tube.

The technique commonly adopted for using the Miller-Abbott tube is as follows. The moistened tube with an empty balloon is passed through one of the nostrils, anaesthesia only exceptionally being necessary for this purpose. A couple of draughts of water then facilitate passage of the tube down into the stomach. This organ is now emptied by suction, which can be verified by the fact that any water swallowed is returned clear. Thereupon the patient has to lie on his right side and the suction is shut off. The patient is allowed to drink a little water in small portions and simultaneously the tube is worked downwards 2—3 cm. every five minutes until, after about an hour, the 75 cm. mark has been reached. In favourable cases the tube will then have passed through the pylorus and entered the duodenum. This cannot as a rule be verified without X-ray examination, which is accordingly advisable at this juncture. If it is found that the tube has entered the duodenum, about 20 ml. of air are injected into the balloon and the suction is applied, whereupon the tube is continuously worked downwards at most 15 cm. per half-hour. When the tube has negotiated the pylorus, it effects decompression automatically. As soon as it has aspirated the first segment of the intestine dry, peristalsis sets in again there and the tube is passed on to the next segment, which is sucked dry in its turn and recovers its peristalsis, and so on. In this way the tube can be got to pass through the whole intestinal canal if there is no mechanical obstruction present. As a rule intestinal peristalsis propels the tube rapidly onwards without further measures being required, and decompression usually takes place after a few hours.

It is far from always that the tube passes through the pylorus

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<sup>1</sup> Surg., Gyn., Obst. 1947: 85: 603.

<sup>2</sup> Am. J. Surg., 1946: 72: 137.

<sup>3</sup> Am. J. Surg., 1947: 113: 437.



Fig. 2. J. no. 862/47. Feb. 5 Violently distended small  
intestines. Suction treatment instituted. Tip directed  
towards pylorus.



Fig. 3 24 hour later Tube tip in the top jejunal loops  
Commencing compression



Fig. 4. Feb. 8. The tube has passed upward. Gas filling of ascending colon shows that intestinal passage is begun.



Fig. 5. Feb. 10. Tube tip in ileocecal angle. Complete decompression. Intestinal passage established.



at the first attempt. Inhalation of amyl nitrite at a fresh attempt may sometimes induce that slackening of the pyloric sphincter which is necessary for free passage. When difficulty is experienced in getting the tube through the pylorus, the following procedure affords good help. After the stomach has been sucked empty with 45—50 cm. of the tube put in, the patient is placed on his right side and the stomach is inflated through the suction tube with about 200 ml. of air. During 10—15 minutes the tube is successively inserted up to the 60 cm. mark, whereupon the air is let out. The tip of the tube then mostly lies immediately in front of the pylorus and not infrequently passes through the latter if it is pushed 15 cm. at a time and the patient is simultaneously given a few gulps of water to drink. Adjustment of the tube-tip may, of course, also be effected under control of the fluorescent screen.

With the best technique, however, it is not in all cases possible to get the tube to pass out of the stomach. MC KITTRICK reports 10 failures in this respect among 20 cases, but only in 6 of them were real technical difficulties the cause. LEIGH junior, NELSON and SWENSON report passage in 68 cases of 76. SCHLICHE, BARGEN and DIXON found that they had passage difficulties in more than one-third of their cases but definite failures in only a few. They stress, however, the value of intubation even in those cases in which the tube remains in the stomach. CANTOR, KENNEDY and REYNOLDS had failures in only eight cases of 200. CHESTERMAN says that he never succeeded in getting the tube past the pylorus in those cases of distension and gastric retention in which decompression is particularly necessary.

Quite naturally, the passage difficulties are greatest before personal experience of the technique has been obtained. After such has been acquired failures are very rare, though it may require repeated attempts and take days before the pylorus is negotiated. That we have relatively seldom failed is doubtless due to the position we take to the indications. Contrary to most of the authors cited, we do not as a rule use intubation in mechanical ileus until the obstruction has been operatively removed. With this position as regards indications it does not, of course, play the same dominant rôle whether one or two days have elapsed before the tube passes into the small bowel as in cases where the intubation is intended to replace operation. Naturally, it is also more difficult to get the tube past the pylorus after the state of obstruction has fully developed with a violently distended abdomen and an enfeebled

or suppressed peristalsis. Hence, recourse to intubation should be had as early as possible in the course; indeed, in certain cases this method can be used prophylactically, *viz.* in those in which post-operative difficulties may be expected in getting intestinal passage to start. Like other authors (CHESTERMAN, etc.), we have had the experience that in order to avoid vomiting it may at times become necessary also to insert a tube in the stomach in spite of the fact that the first tube has passed down into the small intestine, this in cases where the gastric atony persists even after intestinal movement has started.

Complications are rarely caused by the Miller-Abbott tube. Cases have been described in which the tube had become knotted in the stomach and consequently difficult to withdraw. It has also happened that the balloon has been too strongly inflated, with the result that instead of being propelled onwards by peristaltic action it has come to form an obturating hinder with risk of injury to the bowel wall. This complication can be avoided by deflating the balloon at regular intervals and then re-inflating with at most 20 ml. of air. In rare cases a suction tube left for a long time *in situ* has caused damage to the laryngeal cartilage with infection and oedema as sequelae. Finally, intubation may cause otitis media, especially in children. None of the complications mentioned here have occurred in our material. On the other hand, it is very common for the patients to be troubled by a feeling of soreness in the pharynx, particularly in cases of prolonged intubation suction. Mostly the discomforts are not so severe as to necessitate special measures being taken.

As previously mentioned, in Anglo-Saxon countries attempts have been made in cases of mechanical obstruction to replace operative therapy with suction treatment or in any case to postpone operation by means of the former. However, suction drainage must as a rule be inadequate if strangulation is present, for evacuation of the intestine can then only in exceptional cases be thought to lead to a reduction of this condition. Now, as is known, strangulations are very common in cases of acute intestinal obstruction. McKITTRICK and SARRIS had 33 % such in their material, SCHLICHE, BARGEN and DIXON had 33 cases out of 136, and DENNIS and BROWN had 23 among 110 cases. In a collection of cases with obstruction of the small intestine published earlier by the present author there were no fewer than 299 cases out of 407 in which a band had been the contributive cause of the ob-

struction. Even if a strangulation obstruction was not present in all these cases, the risk of such occurring sooner or later must have been present in a very large number.

A desirable prerequisite for recourse to intestinal suction in place of operation must accordingly be the ability to discriminate between strangulation and simple obstruction. Here, the anamnesis itself affords some guidance, the onset in strangulating obstruction being much more sudden than in simple obstruction. Moreover, the latter type gives the typical intermittent pains with entirely painless intervals while the former gives a continuous pain that nevertheless intensifies at times, *i. e.* is without pain-free intervals. The conclusive criterion is stated to be the palpation find, however. In simple obstruction the abdomen is generally indolent to palpation with the exception, possibly, of the local tenderness over the point of attachment of the adhesions. At later stages a more diffuse tenderness may also arise on account of exudation from the intestine in consequence of the great distension. On the other hand, in strangulating obstruction considerable tenderness, possibly with a palpable resistance, may be found above the strangulated loop of intestine as well as peritoneal irritation caused by the haemorrhagic exudate. From this rule the sole exception is considered to be invagination, this depending on the fact that the infarcted gut is here enclosed in a cylinder of normal intestine.

WANGENSTEEN considers that on the above-described symptoms it is possible to differentiate strangulation from simple obstruction, and a number of authors agree with him (REA, JOHNSTON, DENNIS and BROWN, etc.). Others, however, take up a more dubious attitude (Mc KITTRICK and SARRIS, AIRD, etc.) and, as a matter of fact, in a large number of the reports issued on suction treatment there are also instances in which this method has been employed in cases of strangulation, quite naturally with an unsuccessful result. Personally WANGENSTEEN has not experienced any failure. At his clinic, however, the cause of death was strangulation in two of the four fatal cases in a group of 57 patients treated solely by suction. McKITTRICK and SARRIS state that in a rather large proportion of their cases they were unable to make the diagnosis of strangulation but first treated these cases by suction, with the result that when the true situation became clear and operation was thus unavoidable they were compelled to perform a resection. DENNIS and BROWN had four deaths among operatively untreated patients with gangrene. SCHLICKE, BARGEN

and DIXON report that in a group of nine patients for whom operation had been postponed in favour of suction treatment there were two cases with gangrene and one with a doubtful intestine. Failures are also reported by ABBOTT and JOHNSTON, BENNET and others. These reports from the literature definitely show the impossibility of diagnosing strangulation in all cases, which entirely agrees with the present author's experience.

Hence, when the diagnosing of strangulation is uncertain, the time factor must play an important part in the choice between operation or suction treatment because the operative risks for the non-strangulating types increase with the duration of the disease, just as the prospects of saving cases with strangulation decrease. As a matter of fact, the position taken towards the therapy has been based to a very high degree on the time factor. CHESTERMAN, for instance, operates on all cases of acute obstruction of the small bowel with a history of less than 24 hours. Cases with a longer history, of course, are subjected to operation as soon as strangulation is suspected. Of cases with a history of between 24 and 48 hours he operates on those which have not previously undergone any abdominal operation, as he considers strangulation common here, while he applies suction to those who have undergone an earlier laparotomy, regarding strangulation as an uncommon phenomenon under these conditions. However, if the earlier operation has been performed for a gynecological disease, CHESTERMAN thinks operation to be indicated up to 48 hours after the onset of obstruction symptoms, this because strangulations are extremely common in these. According to CHESTERMAN, the mortality in cases having a history of over 48 hours is so high that there seems to be reason to try a non-operative procedure, especially if the subject is corpulent, above sixty years of age or otherwise offers a poor operative risk. If the obstruction has not been relieved 36 hours after the institution of suction treatment or after 24 hours' of active suction treatment, operation is always to be considered indicated, and these cases come under operation in so poor a condition that enterostomy is usually the sole remaining alternative.

McKITTRICK likewise operates on all cases with a history of less than 24 hours, besides those suspected of suffering from a strangulation. Patients over 60 years of age who come after 24 hours as well as all who come after 48 hours are treated with suction. If this treatment is not effective in six to eight hours,

operation is undertaken. If the patient is old, in poor condition or has greatly distended intestines, only enterostomy is done by a small incision under local anaesthesia ("blind" enterostomy), but should this disclose blood-stained fluid in the abdomen as a sign of gangrene the operation must, of course, be extended to include a reduction of the obstruction. If, on the other hand, the patient is in good condition and the distension is not of too high a degree, laparotomy is carried out by routine methods.

Thus, an absolute condition for recourse to intestinal suction treatment in place of operation is a continuous meticulous supervision of the patient, firstly to make sure that no signs of strangulation have arisen, secondly to make sure that the suction treatment is having the desired effect. The last-mentioned is shown by the cessation of the pains and the reduction of the distension, which latter necessitates X-ray control to make sure that *all* loops are diminishing in volume. X-ray examination must therefore be carried out — at any rate to begin with — at intervals of at most twelve hours. If the obstruction is relieved by the suction treatment, this result naturally becomes manifest by the presence of gas in the colon, by the diminution of the quantities aspirated, and by the non-return of distension when the suction is cut off. In a certain number of cases suction drainage renders operation completely unnecessary, but not infrequently it will be merely a pre-treatment to get the patients in a better condition for the operation to be undertaken later.

The risk associated with intestinal suction treatment as a substitute for operation in mechanical obstruction must thus be that the mortality of the strangulation cases is raised, even if it may be reduced in cases with simple obstruction. The decisive factor in the question whether suction treatment is to be adopted on these indications must then be how the mortality presents itself in operated material as compared with suction-treated such. In the author's material all cases of obstruction of the small intestine due to adhesions or bands have been consistently subjected to operation. During the period 1943—1946 two patients died out of 43. From 1945 to date no such death has occurred. (The author intends in another connection to analyse his material on this point.) This result is at least well comparable with even the best of those obtained from intestinal suction treatment, and the author is of the definite opinion that the lethality would have risen if attempts had been made to substitute suction drainage

for operative treatment on the above-mentioned indications. *For the present, thus, there is no reason to replace operative treatment with suction treatment in cases of mechanical obstruction of the small intestine.* Still, there are of course exceptional cases that come up for treatment in such a poor state that operation can be deemed hopeless, and a trial with suction treatment is then motivated. Suction treatment should likewise be indicated in cases with very diffuse adhesions and having a history of repeated operations, as the late results become worse for every new operation (KROOK) and, in addition, the risk of strangulation must be minimum if the abdominal cavity is practically obliterated. Suction treatment acquires its essential importance for mechanical obstruction when it is instituted postoperatively. Decompression as a result of this treatment brings about a surer and quicker opening of the passage than is obtained without it. If, at the operation, it has been necessary to open the intestine, the decompression naturally means that the risk of suture insufficiency will be substantially reduced.

The principal field of indications for intestinal suction treatment is intestinal obstruction of predominantly non-mechanical origin. Here we have mainly three obstruction-promoting factors. First and foremost comes the primary common infection or trauma. Then the secondary intestinal distension, which, by causing an impairment of the circulation in the intestinal wall, prevents the return of peristalsis even when the primary factor is overcome. Finally, in cases of infection, there are also relatively minor mechanical obstructions in the form of agglutinations in the abdominal cavity. These mechanical obstructions are usually of the kind that normal intestinal peristalsis can overcome them. They therefore only possess clinical importance in cases already having a weakened peristalsis. In these, mainly paralytic ileus cases, no considerable risk of strangulation need be apprehended and it is not of crucial importance, if, in their treatment by suction, it takes some hours or even one or two days before the tube passes through the pylorus. Even if once in a while the tube should not be able to negotiate the pylorus, the treatment has nevertheless been of benefit by evacuating the stomach, which not uncommonly is sufficient to get the system in order. In any case no therapy of importance has usually been neglected on account of the intubation. When the tube has passed the pylorus, it automatically initiates that decompression which is required to remove one

of the most important factors inhibiting peristalsis. Passage of the tube of its own accord is proof that peristalsis is returning after the intestinal distension has been removed. As a rule this return of normal peristalsis also enables any minor mechanical obstruction that may be present to be overcome. In other words, the tube breaks the vicious circle that is often present. And even if on any occasion this relative obstruction cannot be definitely overcome, the suction treatment has usually afforded a possibility of putting off the operation until a more suitable time, *i. e.* until the risk of infection has been overcome. Further, there is no doubt that if operation is inevitable in such a case it is technically much simpler to carry out than is otherwise the case, this because it is performed on an abdomen with collapsed intestines. Moreover, the suction drainage facilitates the maintenance of the fluid balance, firstly because the risk of plasma-loss which intestinal distension involves is evaded and secondly because, following the decompression brought about in an intestinal segment concerned, the latter recovers the absorptive powers it had lost as a result of its distension. A certain amount of enteral nourishment of the patient is then possible, provided the tube reaches down to the absorptive part of the intestine. Lastly, it may be mentioned that Anglo-Saxon authors claim that the tube also facilitates X-ray diagnosis by enabling small amounts of contrast medium to be deposited at the desired point in the intestinal canal. This will scarcely be awarded the same importance if — as is the case in Scandinavia — the value and harmlessness of passage examinations with contrast media during a progressing ileus state have been recognized (Koch).

*Thus, the proper fields of use indicated for intestinal suction therapy are postoperative treatment of mechanical obstruction, postoperative treatment in cases of incisions into the intestine (suture protection) and non-mechanical obstruction of the small bowel of various kinds, mostly paralytic ileus associated with states of infection in the abdominal cavity. In these conditions intestinal intubation suction is undoubtedly an excellent expedient.*

The following case histories may serve as typical examples of the fields of indication for intestinal suction treatment.

Female, b. 1922. J. no. 1267/47. Delivered Jan. 24 at Obstetr. Dpt. of Södersjukhuset with high forceps on account of fever and menacing asphyxia of foetus. The after-course was normal until Feb. 5, when the patient began to have aching pains in the abdomen. This organ

became more and more swollen, the passage of flatus was scanty, and on Feb. 9 vomitings commenced. Temp. after Feb. 10: 38—39°. The patient was transferred to the Surgical Clinic in a rather affected condition on Feb. 14. Her abdomen was considerably distended, with only slight tenderness. X-rays (general survey) disclosed great distension of both the small and large intestine. Chemotherapy and fluid-balance control were continued and in addition a Miller-Abbott tube was inserted. This immediately passed the pylorus. Negative balance up to and including Feb. 17 (see Table below), but during these days there were increasing decompression, falling temperature and an improved general condition. The tube was removed on Feb. 19 and the patient discharged on the Feb. 25.

Day	1st	2nd	3rd	4th	5th
Suction-drained . . . . .	2100	2130	2600	1575	shut off
Fluid-intake . . . . .	0	1550	1450	1100	1100
Balance . . . . .	—2100	— 580	—1150	— 475	+1100

The grave state of obstruction in this case, secondary to a septic parturient complication, must have been of predominantly paralytic nature, which is shown by the gas-filled colon loops, but a mechanical obstruction of some degree may also have been present. The early institution of chemotherapy and control of fluid balance did not bring any improvement in the patient's condition, whereas the improvement after the Miller-Abbott tube had been inserted and decompression had commenced was very tangible. What the course would have been if suction treatment had not been employed, is naturally impossible to judge with any certainty. In the light of earlier experiences the patient's chances would in that case have undoubtedly been extremely dubious.

Female, b. 1903. J. no. 9585/47. After 2½ years' pains of the gall-stone type the patient was submitted on Dec. 1 to a cholecystectomy under spinal anaesthesia. The gall-bladder, which contained some fifteen stones the size of hazelnuts, exhibited only mild chronic inflammatory changes. The patient lay subfebrile the first post-operative week. After the operation, however, her abdomen became increasingly distended, and her bowels failed to move with ordinary means. Repeated vomitings on Dec. 5 of altogether about ½ litre, after which another litre was pumped up. On Dec. 6 an X-ray survey disclosed considerable gaseous distension of the small bowels and colon as well as several fluid levels. A Miller-Abbott tube was inserted but could not be got past the pylorus until the following day. X-ray controls on the following days showed immediate initiation of a rapidly increasing decompression, besides which the quantities sucked up through the tube were rapidly diminishing (see Table below). The



tube was taken out on Dec. 9. The patient was now in good condition, and was discharged from hospital on Dec. 12.

Day	4th	5th	6th	7th
Suction-drained .....	1800	1400	650	50
Fluid-intake .....	950	1600	1000	1100
Balance .....	— 850	+ 200	+ 350	+1050

Mild intestinal paralysis is, of course, a normal accompaniment of operative interference in the abdomen. In this case the paralysis was far greater than normally and so pronounced that there was a considerable state of ileus. Probably it would have been possible to alleviate the condition without recourse to intubation, but the patient's immediate relief and the rapid recovery of intestinal passage after the tube had started decompression were none the less striking. With a high degree of probability intestinal suction drainage puts us in a surer position to control obstructive conditions of this type and the risks which in spite of everything are associated with them.

Female, b. 1930, J. no. 4671/47. After abdominal troubles lasting 4—5 days the patient was admitted on June 22 and operated upon for appendicitis *ae. gangr. perf. cum peritonitis circ.* On admission her temperature was 38.9 and there was pronounced tenderness in the lower part of her abdomen, most over the M. B. Appendectomy. Drain with one tube to the bed and one down into the true pelvis. Serum, sulfa, penicillin and fluid treatment was commenced. The patient began vomiting on June 24 and on June 26 the Miller-Abbott tube was inserted and passed the pylorus on June 27. Passage rapidly improved and on June 29 the tube was removed. Vomits recurred on July 9. The Miller-Abbott tube was re-inserted, passage established, and the tube was taken out on July 15. Fresh vomitings on July 21. Miller-Abbott's tube was again introduced and allowed to remain, but suction was disconnected off and on. The patient was practically free from trouble so long as suction was applied, but experienced distress as soon as it was shut off. One week after the operation her temperature had dropped almost to normal and subsequently kept so. The fluid balance was controlled continuously and the patient was given glucose, NaCl, blood, etc. when necessary. On repeated occasions she had normal evacuation and passage of flatus, but, as regular passage could not be obtained by these means, *operation* was decided upon on Aug. 1. The tube could be followed to the obstruction, which was caused by a small intestine being jammed up against another which was adherent to the posterior wall of the abdomen. The obstruction was reduced. No abscess was found, but it was quite clear that residues of such were present, there being blackish coatings of fibrin right up from the mesentery of the small intestine and down

over the intestine away towards the coecum. The postoperative course was normal. The tube was taken out on Aug. 8. It had been shut off most of the time after the operation. Patient discharged Aug. 11.

Day	5th	6th	7th . . . 21st	22nd	
Suction-drained.....	1200	300	150	1200	800
Fluid-intake.....	350	1000	950	1500	1800
Balance .....	— 850	+ 700	+ 800	+300	+1000

Day	23rd. . . . 34th	35th . . . 42nd	43rd		
Suction-drained .....	200	350	0	750	2p.
Fluid-intake .....	1500	1050	1050	750	—
Balance .....	+1300	+ 700	+1050	± 0	—

From the outset there was here a typical combination of some degree of mechanical obstruction and paralytic ileus. The infection was overcome, but in this case the mechanical obstruction was or became sufficiently strong to give rise to ileus. Hence this case demonstrates several of the advantages of intubation treatment. First and foremost its ability in the common cases of combined paralytic and mechanical ileus to restore passage, which mostly leads to definitive recovery. Further — if the mechanical obstruction remains stubborn — it affords the possibility of postponing operative reduction of the obstruction to a favourable time from the point of view of infection, which depends not least of all on the fact that the tube promotes absorption in the intestinal segments situated above it.

Female, b. 1923. J. no. 10172/47. Operated upon in Nov. 1946 at another hospital for rupture of a tubal pregnancy on right side. Appendectomy simultaneously. Admitted here Dec. 13, 1947, and operated upon the same day for ileus due to strangulation after a history of abdominal pains and vomitings lasting not fully 24 hours. Patient in seventh month of pregnancy. The obstruction was located on the ileum about 2 dm. from the coecum. Distinct furrow caused by a band. A number of adhesions were separated. The patient had minor vomits on Dec. 15 and 16. Her abdomen became more swollen, intestinal movements did not start, and X-ray examination showed much gas in small bowels; therefore on Dec. 18 a Miller-Abbott tube was inserted, which the same day entered the duodenum. By Dec. 20 and 21 her abdomen had begun to subside and passage to start (the tube being far down in the small intestines), but the patient had a couple of vomitings and therefore a tube was also inserted into the stomach. Recovery swiftly followed. On Dec. 23 both tubes were withdrawn, and the patient was discharged on Dec. 27. The fluid balance was recorded as usual.

Day	5th	6th	7th	8th	9th	10th
Suction-drained.	950	700	625	1300	350	150
Fluid-intake....	900	1300	1950	1800	800	1100
Balance .....	— 50	+ 600	+1325	+ 500	+450	+ 950

The case exemplifies the use of intestinal suction treatment after operative reduction of a mechanical obstruction as well as the previously mentioned fact that at times it is of advantage to insert a second tube in the stomach.

Male, b. 1930, J. no. 862/47. On Dec. 22 and 28, 1946, rapidly passing abdominal pains and vomits. The trouble returned on Jan. 31, 1947. Admitted and operated upon the same day. Intussusception present in which the apex of the intussusceptum was Meckel's diverticulum. Gangrenous intestine. Resection with end-to-end suture. Anastomosis 6 cm. from the ileocecal angle. No passage started and on Feb. 5 the abdomen was thoroughly swollen, and therefore the Miller-Abbott tube was inserted. It immediately passed through the pylorus. Prompt decompression followed. Tube withdrawn Feb. 10. Patient discharged Feb. 14.

Day	6th	7th	8th	9th	10th	11th
Suction-drained.	960	2175	2050	450	100	100
Fluid-intake ....	600	1000	1000	1000	1000	1000
Balance .....	—360	—1175	—1050	+ 550	+ 900	+ 900

In this case, too, the tube was used for decompression after operative reduction of the obstruction and, here, especially as a suture shield. It seems probable that the tube acted as a life-saver in this case of resection and negative fluid balance up to eight days after the operation.

In our material the tube has in no case been used as a substitute for operation in mechanical obstruction.

### Summary.

Various tubes have been designed for intestinal suction treatment. In the author's material the Miller-Abbott tube has been employed. The technique is described. With the indications for its use given by the author the tube admits as a rule of being got past the pylorus, even if sometimes not until after repeated attempts. Complications caused by the tube are rare, and none such have occurred in the author's material. The differential diagnosis between obstruction due to strangulation and simple obstruction is discussed. It is the author's opinion that it is not

possible in all cases to make this differential diagnosis sufficiently early. The significance of the time factor for the indication position *suction treatment contra operation* is mentioned. There would seem to be no doubt that the risk associated with intestinal suction treatment as a substitute for operation in mechanical ileus is that the lethality is increased in the strangulation cases, even if it is perhaps reduced in the cases of simple obstruction. An issue of decisive importance for the question whether suction treatment should be employed on these indications must then be how the lethality presents itself in operated material as compared with suction-treated such. In the author's material, operation has been consistently performed. The result is to say the least well comparable with even the best obtained by suction treatment, and hence there is no reason at present to replace operative treatment with suction treatment as a general rule in mechanical ileus. Certain conceivable exceptions are stated. The fields of indications for intestinal suction treatment are postoperative treatment of mechanical conditions of obstruction, postoperative treatment in cases of operation on the small bowel (suture shield), and non-mechanical obstruction of all kinds. As a rule the tube brings about a decompression and, with it, often a definitive clearing up of a relative obstruction or, if the latter is not the outcome, in any case a possibility of putting off the operative intervention till a favourable point of time. Suction treatment facilitates the maintenance of the fluid balance and renders possible a certain amount of enteral nourishment of the patient. Lastly, the fields of indications for intestinal suction treatment are illustrated by some typical case histories.

As regards the literature reference may further be made to KROOK — Obstruction of the Small Intestine due to Adhesions and Bands — Acta Chir. Scand. 1947, 95: suppl. 125.

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